

their publications with so much ability, leading, by means of the investigations and experiments of Barlow, Hodgkinson, Stephen on, Fairbairn, and others, the old world into a channel which, since the success of the Britannia Bridge, was followed but too willingly and too exclusively.

Gross, and doubtless most important as the results of the investigations of those English engineers at that time were, nevertheless they should not have been accepted as exclusive dogmas, since no pains had been taken to examine with equal care the opposite way, by which the problem could be solved mechanically.

It is the merit of the American engineers to have done this, and to have proved practically that pin connections indeed, if properly arranged, offer greater advantages for bridges and similar structures than can be expected from rivet joints, more especially for large spans.

For some time doubts have been expressed whether the rules given by the English engineers mentioned are correct with reference to rivet-connections. The question has been discussed and has been investigated whether punching of rivet holes is not less mechanical than drilling. Experiments have been made, and in connection with proper arguments results have been obtained which throw new light on this mode of making connections, and finally, conclusions have been reached, which no longer admit of considering these joints as perfect.

More arguing already leads to the conclusion that any hole, punched or drilled in a bar, not only diminishes its cross-section, but that it must necessarily change the previously uniform distribution of strains over the remaining part of the section of the bar in such a manner that *much larger strains* must be produced in the neighborhood of the hole. Apparently this phenomenon originates from the strains which exist in the strip lost by the hole and which by shearing force must be transferred to the remaining section of the bar. The maximum strain being the deciding one, necessarily the efficiency of its net area must be diminished in the same ratio as the maximum strain is larger than if the total strain were uniformly distributed over this section.

Anyone can convince himself easily of this truth by executing Mr. Forney's experiment of punching a round hole in a sufficiently long rubber band, of preparing with a lead pencil two parallel lines close to and equally apart from the center of the hole across the band, and of finally rolling each of the ends of the band over a lead pencil. By drawing these two pencils apart uniform strains will be produced over the area of the band, but in the neighborhood of the hole the pencil lines will no longer be parallel, but will be remarkably further apart than near the outside edges of the rubber band, thus proving that the tensile strains near the hole must be larger than those near to the edges.

The American Master Mechanics' Association has made some experiments on perforated plates, and has found that with punched holes there is connected a loss of 36 per cent., and with drilled holes there is still a loss of 16 per cent. of the original strength of the remaining net area. Having found this result, the experiments were continued with single shearing rivets, under which the connections were almost equally strong whether the holes had been punched or drilled. The strength of the joints was about 20 per cent. weaker than could be expected from the original strength of the net area of the iron, which is a result about agreeing with Mr. Fairbairn's experiments. The American experiments consequently gave evidence that a part of the loss of strength by punching was replaced by the friction of the rivet heads, so that the punched and riveted plates finally equalled those with drilled holes and on account of the less sharp edges of the holes rather showed a slight advantage. The investigation of the strength of rivet joints of punched or drilled plates, by reasons of arguments as well as of the reported experiments, leads to this conclusion: A rivet joint without the proper friction must be connected with a *loss* of the original strength of the remaining area of the joined plates. The friction does not simply increase the strength of the joint, which by English and also by French engineers for a time was considered to be sufficient if only the holes were filled properly. But on the contrary any rivet joints without the sufficient friction caused by the heads must be considered to be weaker than the original strength of the reduced area of the joints. It is only with joints of three rows of rivets one behind the other (single as well as double shearing) that it is possible to reach the original strength due to the iron of the net area of the most weakened section.

This very essential head-friction equalizes the strains, but it is not at all represented in any of the formulae given for such joints. From this we also are led to conclude that these formulae are not as trustworthy as we are informed, since so much depends on the degree of friction, which again rests on the degree of heat of the rivet, on the ductility of the rivet iron, as well as on the more or less unreliable degree of perfection of execution.

Any of these rivet calculations, besides, is very rough, and is based on utterly unscientific suppositions, for the strains in the rivet-holes and rivets themselves are of an exceedingly complicated nature and cannot be determined with even the application of the highest analytical mechanics.

Another point of great importance, and one which has not yet received sufficient attention, is this, that experiments on riveting carried to the ultimate strength are unfair in principle when applied to the wants of bridge building. Bridges and similar structures of proper design and under the supposition of proper material and execution will not break down by imposing ultimate loads; but, as Mr. Woehler has discovered and has proved so as to leave no doubt, may break down after a sufficiently large number of repeated strains lower than the ultimate strength of the material.

If we must have trustworthy rules at all for the strength of rivets or of pin joints, being such as to coincide with the pur-

poses of bridge-building, it will be indispensable to test the different modes of making joints on repeated strains and impacts in a manner similar to that used by Mr. Woehler for plain bars. It also will be indispensable to cut pieces from ordinary girders which were manufactured *without the intention* of being used for experiments, and at the same time it would be necessary to test in the same manner carefully the qualities and the strength of the same material of which the riveted joints were made. With such tests practical rules could finally be obtained.

It is rather difficult to improve the present formulae by introducing the friction, for it can hardly be calculated. Only this much we do know, that the heads of new and well-driven rivets exert friction which corresponds with the extension of the shank beyond the elastic limit.

At present we only have to deal with experiments made on joints with plates of small sections. The diameters of the rivets also were small and their heads easily formed. These joints could very easily be executed with sufficient care, and certainly were made by using the best material.

Thus Fairbairn's original experiments, published in his book on "useful information," were made with iron of only $\frac{1}{4}$ square inch of section, not quite $\frac{1}{4}$ inch thick, the rivets having diameters of but $\frac{1}{4}$ inch and $\frac{1}{2}$ inch. The experiments of the Master Mechanics' Association were made on plates of but 0.35 square inches of net section and with $\frac{1}{4}$ inch rivets. Such rivets can be driven easily and, as is usually the case with such experiments, most probably they were considerably better than they would have been under ordinary circumstances of manufacture. Especially may it be expected that the holes fitted exactly and were carefully prepared with reamers and not with *drift-pins*. The rivet shanks were only $\frac{1}{4}$ inch long.

Notwithstanding these advantages in favor of the rivet-joints, Mr. Fairbairn's report gives evidence that his machine-made joints were about 20 per cent. stronger than those made by hand, and that hand-made joints executed with special care proved to be 14 per cent. stronger than if made with ordinary care. This result is plausible, and the joint-plates being only two in number and only 0.22 inch thick, what differences of strength may be expected when, as in the Danier Bridge, near Tiraspol, in Russia, 16 $\frac{1}{2}$ -inch plates have to be joined by 1-inch rivets.

According to the writer's knowledge only few experiments can be recorded of rivet joints with stronger plates (as for instance Brunel's experiments with $\frac{1}{2}$ -inch plates). These, however, prove that joints with two rows of rivets give a strength of about 94 per cent. of the original value of the net area, while three-row riveting resulted in the utilization of the full strength. Since we know that single-row joints give a utilization of 80 per cent., according to Brunel's experiments, we are led to assume that the second row adds 14 and the third row the final 6 per cent. of strength. Here it must be remarked what great amount of labor is needed in order to achieve this end. It also should not be overlooked that even in these experiments the rivet-shanks were only one inch long, that we have to deal again with tests made on specimens which were prepared for the purposes of experimenting. Also the iron was of the Staffordshire case, and probably remarkably ductile.

Experiments with such iron will be very favorable to the results, much more so than would be the case if the ductility of the iron had first been removed by cold rolling. Under this condition but small changes of form would have preceded the rupture, and the favorable equalization of strains and of the pressures in the holes would have been replaced by conditions more like those which happen to a bridge whose iron by the maximum movable loads is only subjected to strains within the so-called limit of elasticity.

The construction in the shops of large structures with riveted joints is still connected with other difficulties. These consist in forming the joints of angle irons, for which, according to the writer's knowledge, we have no experiments; further they consist in the contraction of the rivet iron when cooling, also in the necessity of close packing of many plates, and in the more or less imperfect upsetting of the rivet shanks, the effect of which again is diminished by contraction.

It is true that the coincidence of the holes and the close packing of the plates can be and is secured in all European first-class establishments by the use of almost perfect punching machinery, and, better still, by boring through all plates at once, as well as by previously rolling the plates, which, for this purpose, have been brought to a dark red heat and have been cleaned from scale. But the two other conditions cannot be fulfilled with perfect safety, and have therefore been avoided by the use of turned, tapering bolts, as in the Rhine bridge at Mainz, or by cold riveting of turned bolts in Ruppert's Hungarian bridges. But in these structures the metal must necessarily be less utilized, since the friction of the rivet heads does not assist, and therefore a loss of about 16 per cent. must be expected.

The longitudinal tension connected with the contraction of well-driven rivets, as any practical iron man will know, is connected with the effect that the rivet heads will fly off if the rivet iron is not of great ductility and of a quality to be very strong under ordinary temperature. It is known how easy it is to cut off the heads of rivets by giving a few blows on a chisel set transversely against it, and it is also known that the fracture always looks crystalline, since the iron was under a state similar to the artificial condition of hardened steel. During the execution of the great Dirschau Bridge across the Vistula River, in Germany, the rivets are reported to have lost their heads so frequently that the engineers had to arrange for partly counter-sunk heads, which, of course, caused an addition of cost, since every hole had to be reamed conically. The rivets of the top chords of the Nogat Bridge, formed with a tubular top-chord following the example of the Britannia Bridge, could not even stand the heat of the sun, and riveting during night was resorted to under the light of lanterns. It is

reported that the Victoria Bridge in Canada loses its rivet heads in such number that pails filled with them can be noticed, and that new rivets have to be placed continually. Even hollow columns, as long as the rivets were not made of a special brand of iron, lost their heads when exposed in the yard to the direct effect of the sun.

The longitudinal tension caused by contraction of a rivet must be considered as a constant value, and, as long as the same is not remarkably increased by strains arising from the movable load, its wear and tear will not progress as rapidly as when the heads are repeatedly exerted and finally loosened by vibrations and direct strains. This is the reason why rivets such as those which connect laterally the staves of a compression member must be considered as sufficient, while those rivets which serve to transfer tensions and compressions by means of cover-joints are by far less reliable and must necessarily sooner wear out than the rest of the girder.

All these arguments lead to the conclusion that riveting does not prove to be as perfect and as faultless as many engineers seem to believe.

From the experiments with single rivet-joints we turn to experiments made on finished girders. These divide into experiments on flexure, into experiments on ultimate strength under a single test and in such by which the final rupture was caused by repeated strains less than the ultimate strength and by impacts.

[TO BE CONCLUDED NEXT WEEK.]

Transportation in Congress.

In the Senate on the 9th:

The bill for the incorporation and regulation of railroad companies in the territories was taken up.

On a motion of Mr. Wright, of Iowa, the section giving right of way 200 feet wide through all public lands, with authority to take from such lands all materials needed for the construction of road and buildings was struck out.

On motion of Mr. Bayard, of Delaware, the section authorizing corporations to acquire by purchase or gift any land in the vicinity of the road and convey them at the pleasure of the directors was struck out.

On motion of Mr. Pratt, of Indiana, an amendment was made so as to grant for stations and other structures 10 acres of public lands per 10 miles of road, instead of 40.

On motion of Mr. Clayton, of Arkansas, an amendment was made requiring every company to maintain an office somewhere on its line and keep its books there open for inspection.

On motion of Mr. Hager, of California, the bill was amended so that it shall not apply to the District of Columbia.

The discussion was resumed on the 10th, and the motion of Mr. Buckingham, of Connecticut, forbidding the crossing of any Indian reservation by any road was agreed to. The amendments thus made in Committee of the Whole were concurred in by the Senate.

Mr. Wadleigh, of New Hampshire, offered the following amendment, which was agreed to:

That Congress may, at any time when in its opinion the public good may require it, add to, alter, amend, or repeal this act, and whenever any Territory or any part thereof in which the railroad is located shall be admitted into the Union as a State, the Legislature of any such State may at any time add to, alter, amend, or repeal this act, so far as it relates to any such railroad, or any part thereof which shall be within the territory of said State.

Mr. Bayard, of Delaware, moved an amendment to provide that, in organizing a corporation for the construction of a road, a majority of the persons applying for the charter shall be resident in the Territory or Territories where the railroad proposed is to be built. Agreed to.

Mr. Bayard offered an amendment providing that the amount of capital stock of any road shall not be less than \$10,000 per mile. Agreed to.

In the Senate on the 13th, in Committee of the Whole, the discussion of the general railroad law for the Territories as resumed. Mr. Wadleigh's amendment, adopted Friday, was amended so as to provide that Congress only may add to, alter, amend or repeal the act. Amendments were agreed to giving to the Legislature of any State which may hereafter be formed out of a Territory in which a railroad authorized under the act may be located, the same power over such corporation as it would have over one of its own creation; making the stockholders of any road organized under the act individually liable for an amount equal to the amount of stock subscribed for by them for all debts contracted by the road; and declaring that any such road or telegraph should provide for the transmission of mails and messages for the Government of the United States for a compensation not to exceed that paid by private parties for similar service.

The bill was then reported to the Senate, and the amendments made in the Committee of the Whole were concurred in.

Mr. Conkling offered a substitute for the liability clause of Mr. Pratt, that every stockholder in every corporation to be formed under this act shall be liable for all debts of said corporation contracted while he held the stock to an amount equal to the amount of stock of which he is the holder, at the par value thereof. Agreed to.

The bill was then read a third time and passed—Yeas, 30; nays, 18.

In the Senate, on the 14th:

Mr. Scott, of Pennsylvania, from the Committee on Finance, reported back the bill to provide for the payment of the bonds of the Louisville & Portland Canal Company, with a recommendation that the House's substitute for the bill be adopted with certain amendments. Placed on the calendar.

Mr. Dorsey, of Arkansas, introduced a bill to incorporate the Washington City & Atlantic Ocean Railroad Company. Referred to the District Committee. Also, a bill to establish a National Railroad Bureau, and for the general government of railroads. Referred to the Transportation Committee.

Train Accidents in March.

On the afternoon of the 1st, a car of a stock train on the New York Central & Hudson River Railroad was thrown from the track by a broken flange as the train was crossing the bridge over Genesee River at Rochester, New York. The car went off the bridge and down into the river, falling on its side, and was badly wrecked.

On the evening of the 1st, on the Central Pacific road near Blue Canon, five engines attached to a snow plow ran off the track, doing much damage and blocking the road eight hours.

On the morning of the 2d, on the Burlington & Missouri River Railroad near Burlington, Ia., a plug blew out of a flue and the engineman and fireman were badly scalded, the latter being further injured by jumping from the engine.

On the 2d, on the Chicago, Dubuque & Minnesota road near Gordon's Ferry, Ia., a plug blew out of the boiler and the engineman and fireman were badly scalded by the escaping

steam. The fireman jumped from the engine and was killed.

On the night of the 2d, near Truckee, Nev., on the Central Pacific Railroad a freight train went off the track and into the ditch. There was much snow on the track at the time.

On the 2d, a construction train on the Baltimore, Pittsburgh & Chicago Railroad jumped the track near Chicago Junction, O. The whole train went into the ditch and the conductor was killed.

On the morning of the 3d, a special train on the Chicago, Burlington & Quincy road loaded with delegates to the Kane County Farmers' Convention was thrown from the track by a misplaced switch near Geneva, Ill., and the engine was damaged.

On the morning of the 3d, on the Buffalo & Jamestown road near Eden, N. Y., several cars of a mixed train were thrown from the track by the breaking of a truck under a freight car.

On the afternoon of the 3d, on the Keokuk & Des Moines Railroad near Comstock's, Ia., seven cars of a freight train were thrown from the track and wrecked by a broken rail. A brakeman was injured.

On the night of the 3d, in Norfolk, Va., on the Atlantic, Mississippi & Ohio road, as a freight train was backing up to the depot two cars jumped the track.

On the night of the 3d, on the Detroit, Lansing & Lake Michigan Railroad, near Howell, Mich., a passenger train was thrown from the track and wrecked by a tree which had fallen across the track.

On the night of the 3d, on the Marietta, Pittsburgh & Cleveland Railroad, near Phillipsburg, O., the engine of a passenger train was thrown from the track and slightly damaged by a white oak sapling which had been put on the track and fastened by running one end down into a water-way. A few minutes before the same train had passed without injury a rail laid across the track.

On the morning of the 4th, on the New York, New Haven & Hartford road near Thompsonville, Conn., as some ties were being thrown from a flat car while the train was in motion, one fell on the track and threw three cars into the ditch.

On the morning of the 4th, a steamboat exploded on an engine in the yard at Richmond, Ind., on the Pittsburgh, Cincinnati & St. Louis Railway.

On the 4th an east-bound freight train on the Indianapolis, Bloomington & Western was thrown from the track near Bloomington, Ill., blocking the road some hours.

On the 4th, a stock train on the Toledo, Wabash & Western Railway ran over a cow about two miles east of the Hannibal Bridge. The engine and nine cars went into the ditch and a number of cattle were killed.

Late on the night of the 4th, on the Toledo, Wabash & Western Railway, near Buck Creek, Ind., a freight train ran into the head of another freight which had backed into a siding, but did not quite clear the main track. Two engines and several cars were thrown down the bank, and two brakemen injured.

Early on the morning of the 5th a train on the Macon & Brunswick road ran off the track near Jesup, Ga., wrecking several cars and injuring 16 persons.

On the morning of the 5th, on the Central Railroad of New Jersey, near Roselle, N. J., a coal car jumped the track and running across threw from the track several cars of a freight train which was passing on the other track.

About noon on the 5th, a train on the Norristown Branch of the Philadelphia & Reading road was thrown from the track by a misplaced switch at Conshohocken, Pa. The engine was badly wrecked and the road blocked some hours.

On the night of the 5th, the baggage car and two coaches of the west-bound express train on the Indianapolis, Bloomington & Western road were thrown from the track near Leroy, Ill., by the spreading of the rails.

On the morning of the 6th, on the Vermont & Massachusetts Railroad, the brakebeam of the tender of a freight train fell on the track as the train was crossing a bridge near Baldwinville, Mass., throwing five cars from the track and badly damaging the bridge.

On the 6th, two engines and a snow-plow on the Central Pacific road ran off the track near Wells, Nev., killing a brakeman.

On the night of the 6th, at Kankakee, Ill., a north-bound mail train on the Illinois Central ran into some freight cars which had been blown by a heavy gale from a siding to the main track, wrecking two cars and damaging the engine.

On the night of the 6th, on the Illinois Central at Paxton, Ill., a south-bound express ran into two cars which had been blown from a siding on to the main track. The engine was badly damaged.

On the 7th, on the Central Pacific road near Verdi, Nev., a snow-plow jumped the track and went down a bank 25 feet high, injuring the conductor and a brakeman.

On the afternoon of the 7th, on the Central Pacific Railroad near Blue Canon, a snow-plow and one of the engines driving it went off the track in a heavy snow storm.

On the afternoon of the 7th, a train on the Muscatine Division of the Burlington, Cedar Rapids & Minnesota was crossing the bridge over Wapsie Creek, it gave way and the train went down into the creek. One abutment of the bridge had been washed out by a freshet.

On the afternoon of the 7th, on the Detroit, Lansing & Lake Michigan road, near Salem, Mich., the boiler of a locomotive attached to a freight train exploded, wrecking the engine and injuring the engineer and the roadmaster, who was riding with him. The barrel of the boiler was torn to pieces, but the firebox and rear end were not much damaged. The engine had just shut off steam. No cause is assigned for the explosion of the boiler, which was about two years old.

On the evening of the 7th, on the Philadelphia, Wilmington & Baltimore, near Old Road station, a car of a passenger train jumped the track, blocking the road for an hour.

On the evening of the 8th, on the Texas & Pacific Railroad, near Scott's Station, a passenger train ran over a bull, throwing the engine into a ditch and injuring the engineer and one of his men.

On the morning of the 9th, on the Winona & St. Peter road, near Rochester, Minn., the engine of a working train blew out one of her cylinder heads.

On the 9th, on the St. Paul & Pacific Railroad, near Wayzata, Minn., six cars and a caboose of a freight train were thrown into the ditch and a brakeman injured.

On the 9th, a train on the Chicago & Northwestern road jumped the track between Geneva and St. Charles, the engine and three cars going down the bank and injuring the engineer and fireman.

On the 9th, on the San Francisco & North Pacific Railroad, at Healdsburg, Cal., as the engine of a freight train was trying to run some cars on a side track by a flying switch, the switchtender failed to turn his switch quickly enough, and the cars ran into the rear of the engine, breaking the tender badly.

On the evening of the 9th, on the Texas & Pacific Railroad, a construction train, the engine of which was running backward, ran over a cow near Dallas, Tex., throwing the tender from the track and killing a laborer, who was on the tender.

On the night of the 9th some cars of a freight train on the New York Central & Hudson River road were thrown from the track between Utica and Frankfort, blocking the road some hours.

On the morning of the 10th, on the Erie Railway, near Deposit, N. Y., a freight train ran off the track, obstructing both tracks for several hours.

On the 10th, on the Syracuse Northern road, the engine drawing the pay-car ran off the track near Holmesville, N. Y., delaying trains some hours.

On the morning of the 11th, a north-bound freight train on the Petersburg Railroad was thrown from the track between Stony Creek and Beam's, Va.

On the 11th, a south-bound freight train on the Petersburg Railroad went into the ditch near Pleasant Hill, Va., wrecking several cars.

On the 11th, on the Chicago & Lake Huron, near Millett's, Mich., several cars of a mixed train were thrown from the track and in the ditch by a broken wheel.

On the night of the 11th, six cars of a freight train on the Amboy Division of the Pennsylvania Railroad were thrown from the track and wrecked near White Hill, N. J.

On the 12th, the engine of a freight train on the New York Division of the Pennsylvania Railroad ran into a New Jersey Central train at the crossing of the two roads in Elizabeth, N. J., badly damaging the Central tender.

On the 12th, the engine of a mail train on the New York & Oswego Midland road was thrown from the track near Westfield, N. Y., blocking the road two hours.

On the afternoon of the 12th, at Oshkosh, Wis., on the Chicago & Northwestern Railroad, the locomotive of a freight train jumped from the track and came down on a side track six feet distant with all the wheels on the rails. The tender was thrown across the track, the cars all remaining on the rails.

On the night of the 12th, on the Missouri Pacific, 10 miles west of St. Louis, a freight train ran off the track and blocked the road some time.

On the night of the 12th, a freight train on the West Wisconsin Railroad was thrown from the track by a misplaced switch, blocking the road some hours.

On the night of the 12th, on the Memphis line of the Louisville & Nashville road, near Stanton, Tenn., an east-bound passenger train ran over a cow and went into the ditch, severely injuring the engineer, fireman and a lady passenger who jumped from the train.

On the morning of the 13th, in Mansfield, O., at the crossing of the Atlantic & Great Western and the Lake Erie Division of the Baltimore & Ohio, a switching engine of the latter road struck the engine of an Atlantic & Great Western freight train with just force enough to throw it from the track. The engine ran along on the ties some 30 feet and upon a Howe truss bridge when it turned over, wrecked the bridge, and went down into the creek, killing the engineer.

On the morning of the 13th, on the Kansas City, St. Joseph & Council Bluffs road, three miles from Council Bluffs, Ia., a sleeping coach jumped the track, delaying the train some hours.

On the morning of the 13th, an ore train on the Virginia & Truckee Railroad ran into a land slide at American Flat, Nev., wrecking the engine and several cars.

On the 13th there was a butting collision between a stone train and a freight train on the Indianapolis, Cincinnati & Lafayette road, near Acton, Ind.

On the 13th, on the Syracuse Northern Railroad near Hastings, N. Y., 16 ore cars were thrown from the track, blocking the road half a day.

On the evening of the 13th, on the Morris & Essex Division of the Delaware, Lackawanna & Western Railroad, the engine of a passenger train jumped the track at Washington, N. J., blocking the road some hours.

Early on the morning of the 14th, on the Iowa Division of the Chicago & Northwestern near Blairtown, Ia., the engine and six cars of a freight train were thrown from the track by a broken rail, killing a brakeman and injuring the engineer and fireman.

On the morning of the 14th, near Toano, Nev., two cars of a passenger train were thrown from the track by a broken rail and went down the bank, injuring one passenger.

On the 14th, on the Central Pacific near Blue Canon, a snow-plow and five engines ran off the track, blocking the road nearly a whole day.

On the 14th as locomotive of the Pennsylvania Railroad stood near the end of the pile in the yard at Altoona, Pa., waiting to be cleaned out, a laborer jumped on and started her backward. She ran into another engine and the man becoming frightened reversed the lever and jumped off, leaving the throttle wide open. The engine ran through the round house, through a long machine shop beyond and into the boiler shop, doing much damage to the machinery in the shop, killing one man and badly injuring another.

On the night of the 14th, on the Erie Railway in Paterson, N. J., the connecting rods of an engine broke, damaging the engine badly and throwing it from the track.

Early on the morning of the 15th, a passenger train on the Cincinnati, Hamilton & Indianapolis road was thrown from the track at Morristown, Ind. The engineer jumped and was badly hurt.

On the morning of the 16th, on the Mobile & Montgomery road near Greenville, Ala., a culvert gave way under a passenger train. The engine passed over safely, but the tender and two cars went down and were badly wrecked. The culvert had been weakened by a heavy freshet.

On the morning of the 16th, a passenger train on the North & South Railroad of Georgia went through a trestle bridge which had been undermined by a flood, killing the engineer and badly injuring the fireman.

On the morning of the 18th, a freight train on the Winona & St. Peter Railroad was thrown from the track and into the ditch by a broken rail near Utica, Minn.

On the afternoon of the 18th, at Enfield, N. C., on the Wilmington & Weldon Railroad a freight car was thrown from the track by a misplaced switch.

On the morning of the 19th, at Sharon, Wis., an express train on the Chicago & Northwestern ran off the track, blocking the road some hours.

On the afternoon of the 19th, at Fowler, Ill., on the Chicago, Burlington & Quincy line, a Toledo, Wabash & Western express train ran over a misplaced switch and into a freight train standing on the side track, badly damaging both engines. The freight train had been run on the siding and the signal set right for the passenger train, but the switch had been left open.

On the morning of the 20th, near Jacksonville, Ill., a passenger train on the Toledo, Wabash & Western road ran over a horse, throwing three cars from the track and into the ditch on their sides.

On the morning of the 20th, at Newton, N. J., on the Sussex Railroad, as a mixed train, from which the engine had cut loose to make a flying switch, was entering the depot, the first car jumped the track, doing some damage.

On the 20th, an east-bound freight train on the Central Pacific Railroad ran off the track east of Sacramento, blocking the road three hours.

On the night of the 20th, on the Chicago and Northwestern, at Oshkosh, Wis., some cars of an ore train jumped the track and went into the ditch.

On the evening of the 21st, at Ulin, Ill., on the Illinois Central Railroad, a heavy timber, which had been left lying crosswise on a flat car, struck the tender of a passenger train and knocked off the fireman, badly injuring him.

On the afternoon of the 23d, near Summit, Tex., on the Galveston, Houston & Henderson road, some cars of a mixed train were thrown from the track by the spreading of the rails. A brakeman was injured.

On the night of the 23d, on the Petersburg Railroad, the three rear cars of a freight train jumped the track at Mud Island Gut, N. C., and one was badly wrecked.

On the morning of the 24th, on the Texas & Pacific road, a trestle bridge over Little Cypress River, near Jefferson, Tex.,

which had been undermined by a freshet gave way under a passenger train, throwing the engine, tender and baggage car into the stream, the rest of the train remaining on the track. The engineer was injured and the train killed.

On the morning of the 25th, on the Galveston, Harrisburg & San Antonio road, near Weimar, Tex., three cars of a mixed train ran off the track and into the ditch.

On the afternoon of the 25th, on the New York & Oswego Midland road near Westfield, N. Y., the mail train bound west was thrown from the track and the baggage car wrecked.

Shortly afterwards a wrecking train going to the assistance of the mail jumped the track also near Westfield, wrecking the engine and tender.

On the night of the 25th two cars of an express freight train on the New York & Oswego Midland road jumped the track two miles east of Westfield, N. Y.

Very early on the morning of the 26th, a freight train on the Indianapolis & St. Louis road was thrown from the track at Mattoon, Ill., by a misplaced switch.

On the night of the 27th, on the Erie Railway near Hohokus, N. J., there was a collision between a coal and a freight train by which several cars were wrecked.

Early on the morning of the 28th an express train on the Grand Trunk Railway ran into a special engine which was running ahead of it, near Gananoque, Ont., injuring the engineer, fireman and a brakeman of the express.

On the 28th, on the Virginia & Truckee Railroad at the Fort Homestead Tunnel, Nev., several cars of a freight train jumped the track, where the rails had been thrown out of line by a cave or crack in the ground.

On the afternoon of the 28th, on the Northern Central Railway, the boiler of the engine of a freight train exploded while the train was standing on a siding near York, Pa. The firebox was thrown into a field 18 feet above the track and 400 feet from the point where the explosion occurred, the rest of the engine being thrown up a bank in the opposite direction. A road bridge crossing the track at that point was destroyed. A brakeman, who was on the engine, was killed and the engineer, fireman and another brakeman were badly injured.

On the afternoon of the 28th, in Jersey City, N. J., on the Harbors Branch of the Pennsylvania Railroad, near the junction with the main line, there was a butting collision between two freight trains by which both locomotives and several cars were wrecked, the fireman and a brakeman of one train killed, and the engineer and conductor of the other badly injured. The accident was caused by the telegraph operator at the junction, who had received orders to hold one train, but had allowed it to pass.

On the morning of the 31st, two cars of a freight train on the West Wisconsin road jumped the track near St. Paul, Minn., blocking the road some time.

On the afternoon of the 31st, on the Dutchess and Columbia Division of the New York, Boston & Montreal road at Glenham, N. Y., a bridge fell under a mixed train carrying six cars down 30 feet into the creek.

Very late on the night of the 31st, on the Lake Shore & Michigan Southern in Adrian, Mich., an axle broke under a freight car, throwing seven cars from the track and badly wrecking two of them.

This is a total of 88 train accidents, by which 13 persons were killed and 49 injured.

These accidents may be classified according to their nature and causes as follows:

COLLISIONS:	
Rear collisions.....	4
Butting collisions.....	4
Crossing collisions.....	2
Unexplained.....	1
Total.....	11
DERAILMENTS:	
Unexplained.....	31
Snow on track.....	6
Misplaced switch.....	5
Cattle on track.....	5
Broken rail.....	4
Spreading of rails.....	3
Broken wheel or flange.....	2
Broken truck.....	1
Broken axle.....	1
Broken connecting rod.....	1
Tie falling on track.....	1
Dropped brake-beam.....	1
Malicious obstruction.....	1
Tree blown on it.....	1
Giving in of ground.....	1
Broken bridge.....	3
Bridge or culvert washed out.....	2
Total.....	68
Explosion of boiler.....	2
Explosion of steam-chest.....	1
Cylinder head blown out.....	1
Flue-plug blown out.....	1
Plug blown out.....	1
Lance-hole.....	1
Projecting timber on car.....	1
Runaway engine.....	1
Total.....	13

One collision was caused by bad side-tracking, one by a misplaced switch and two were with cars blown from a side track to the main line. Twenty-two accidents were caused by defects or breakages of road or rolling stock and three of the unexplained derailments (probably many more) can be attributed to bad condition of track.

Twelve accidents caused the death of one or more persons; 14 others caused injuries, leaving 62 accidents which caused no injury to persons.

As in February, the number of accidents is much less than for the same month last year, when 112 accidents were recorded, by which 18 persons were killed and 92 injured. Accidents resulting from snow on the track still continue to be recorded, most of them on the Central Pacific, where more trouble was experienced from snow during March than for all the preceding Winter months. The number of accidents for the month as well as that of killed and injured is considerably below the monthly average recorded for the year.

For the twelve months ending with March the record stands as follows:

Month.....	No. of Accidents.....	Killed.....	Injured.....
April.....	11	23	98
May.....	79	10	113
June.....	90	12	104
July.....	90	18	80
August.....	150	63	155
September.....	106	29	75
October.....	88	11	47
November.....	76	11	50
December.....	80	16	43
January.....	108	18	98
February.....	10	25	49
March.....	18	13	49
Totals.....	1,156	249	951

The average per day for March is 2.84 accidents, 0.42 killed and 1.58 injured; for the year it is 3.14 accidents, 0.63 killed and 2.61 injured.



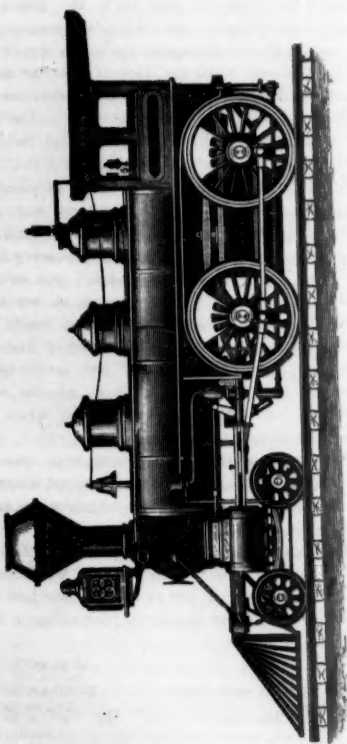
Fig. 1. (Continued from page 10)



Fig. 2. (Continued from page 10)



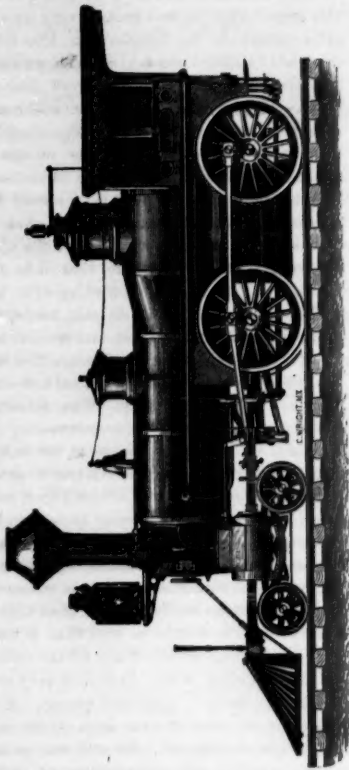
PLATE 1.



AMERICAN LOCOMOTIVE,
BY THE BALDWIN LOCOMOTIVE WORKS, PHILADELPHIA.

Scale, $\frac{1}{8}$ in.=1 ft.

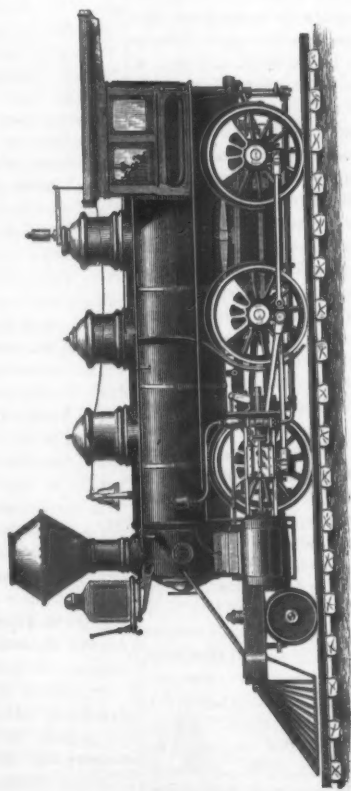
PLATE 2.



AMERICAN LOCOMOTIVE,
BY THE GRANT LOCOMOTIVE WORKS, PATERSON, N. J.

Scale, $\frac{1}{8}$ in.=1 ft.

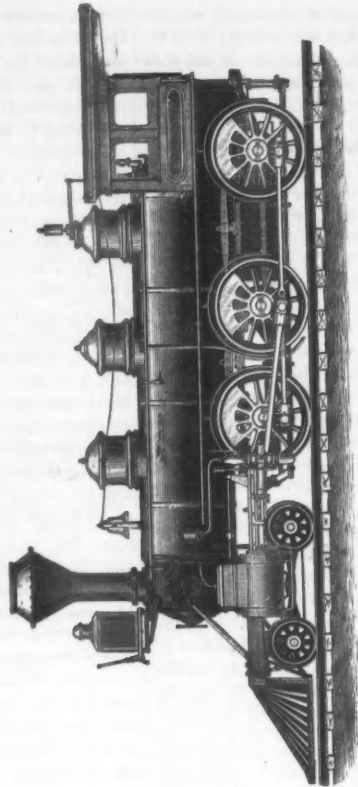
PLATE 3.



MOGUL LOCOMOTIVE,
BY THE BALDWIN LOCOMOTIVE WORKS, PHILADELPHIA.

Scale, $\frac{1}{8}$ in.=1 ft.

PLATE 4.



TEN-WHEELED LOCOMOTIVE,
BY THE BALDWIN LOCOMOTIVE WORKS, PHILADELPHIA.

Scale, $\frac{1}{8}$ in.=1 ft.

failure to make net earnings enough to pay the interest on the bonded debts, we have available \$810 per mile, by taking which from the stockholders and leaving the latter no income at all, we may reduce the average charge for transportation. Now \$310 is nearly 11½ per cent. of the average gross earnings per mile; so by depriving the stockholders of the Illinois railroads of all income whatsoever, whether divided or undivided, the average rates for transportation in that State during the year ending with June last might have been 11½ per cent., or about one-ninth, lower than they actually were.

AMERICAN AND EUROPEAN LOCOMOTIVES.

It is somewhat singular that a difference as great as that which exists in the construction of locomotives in Europe and this country should be maintained. Here for the past twenty years the designs of locomotives have been steadily conforming more and more closely to each other, and probably four-fifths of those now in use are constructed on what has for that reason been called the "American" type. Locomotives of that plan, as constructed by different builders, are now so nearly alike that it is often hard to distinguish those made at one shop from those made at another. In Europe the condition of things is quite different. From the admirable engravings published by our able and enterprising cotemporary, *Engineering*, of the locomotives exhibited at Vienna, a very good idea of Continental practice can be formed. While in this country our practice has to a certain extent settled down to fixed and definite forms, in Europe the widest latitude seems to prevail in the construction not only of details, but in the general plan of locomotives. Here all engines, excepting those used for switching or "shunting," are made with a flexible, or, as the French call it, an "articulated" wheel-base; that is, a truck or "bogie" of some kind is used. In Europe the wheels of probably a large majority of the engines are attached rigidly to the frames. Many freight locomotives there have six or eight wheels, all coupled, and many passenger engines four wheels coupled and one pair of leading wheels, all of which are held rigidly in the frames. There is, it is true, some show of reason for this, as we have heretofore pointed out, in the fact that the tracks of European railroads are usually so much better than ours; but this reason is beginning to disappear as our main lines improve—as many of them have—in this respect. It is, however, undoubtedly a fact that for our rough and crooked roads the "three-legged principle," as it has been called, is very important. This principle is illustrated and was named from the fact that a three-legged stool will stand steadily on any surface, however uneven; whereas with four legs, if they are of the same length, the surface must be a plane in order that they may all bear equally. Our "American" engines in reality rest on three points, those on the centre of the truck in front, and the equalizing beams between the driving wheels. It would, of course, not be impossible to accomplish the same thing with engines having six or eight wheels coupled. Usually, however, this is not done, and even if it were, we would be without the lateral flexibility which the truck gives. We are inclined to believe, however, that the importance of both of these principles has always been overestimated, that the causes which made their adoption necessary have to a great extent disappeared, and that we are now doing what is not unusual—believing in reasons which originally rested on true premises, which have since changed so as to make the conclusions unsound. At the present time, our practice in the construction of heavy freight engines is a sort of compromise between the American truck system and that still adhered to in Europe. The way in which this developed is somewhat singular. Forty years ago the two initial types of engine in use were the "Grasshopper" engine, in use on the Baltimore & Ohio Railroad, and the truck engine on the Mohawk & Hudson Railroad. As the business of these roads increased, larger engines were required. On the Baltimore & Ohio eight-wheeled coupled engines were built, and on the Northern roads the present American type, with four wheels coupled and a leading truck, was designed. These two systems were developed in the two sections, and to a very great extent seemed to be localized in different lines of latitude. With the development of the railroad system the eight-wheeled coupled engines were sent northward and the truck engines southward; so that the two systems met and worked side by side so that their respective advantages soon became apparent. The one gave a much greater adhesive power, and the latter the most flexibility. As these were both important, the next step was to combine the two. To do this engines like that shown in plate 4, on another page, with six wheels coupled and a leading truck, were designed, the object being to give them more adhesive weight than was possible with what has since been called the "American" plan, shown in plates 1 and 2, and at the same time have a flexible wheel-base and to some extent retain the three-legged principle. Many such ten-wheeled engines, as most of our readers know, were built at one time, and we believe it is still the standard form of engine on the Pennsylvania road. They have, however, of late years

not met with much favor outside of Pennsylvania, and on nearly all Western and Northern roads the American plan is preferred. The Bissell truck, however, rendered it possible to make a still closer approximation to the rigid wheel system and at the same time retain, in theory at least, the flexible wheel base. On a ten-wheeled engine it was impossible to bring the front driving-wheels close to the cylinders, on account of the back truck-wheels, which are behind the cylinders. With the Bissell truck, having a single pair of wheels in front of the cylinders, the front driving-wheels can be brought up close to the cylinders (as shown in the Mogul engine, plate 4,) and thus secure more adhesive weight than with the ten-wheeled plan. The next step was to add another pair of driving-wheels to the Mogul plan, thus giving eight wheels coupled with a Bissell truck in front. It will thus be seen that although the flexible wheel-base was nominally retained, yet the length of the rigid wheel-base, in the latter or Consolidation pattern, as it is called, is quite as long or even longer than in the old engines with eight wheels all connected. Doubtless the wheels of the Bissell truck serve a good purpose in carrying the overhanging weight of the cylinders, and are also a safeguard against the breaking of the front axle or wheel flange. The latter is, however, much less liable to happen now, when steel tires are exclusively used, than it was when cast-iron wheels and tires were employed, as they were on the old camel engines. It will thus be seen that our practice in the construction of heavy freight engines is almost unconsciously approximating that which is in use in Europe, and it is possible that the next step may be that some one will conclude that the consolidation plan of engine may be operated without the leading truck wheels. It is of course impossible now to say what may be accomplished by the double-truck system for engines, which Mr. Mason is working out with so much skill, and which, for very powerful engines, certainly has some great advantages. It is obvious, however, that our practice in the general plan of construction of heavy freight engines is approximating that so much used in Europe. In the lighter class of engines, or perhaps we should say in the faster class of engines, the difficulties in the general plan are still maintained. There are, perhaps, some indications that in this direction European engineers are adopting some of our methods of construction, as the truck is now much oftener used than it was formerly. It is probable that a much larger proportion of our engines must be used for fast service in this country than in Europe. Many of our lines which do a heavy business are obliged to do it on a single track, so that trains are crowded and must run fast in order to get out of each others' way. With double-track roads, and a better classification of trains, of course this is not necessary, and longer trains and slower speeds are then possible.

It is not, however, in the general plan of construction alone that our practice differs so much from the European. In all the details there is in Europe a much greater variety of construction than here. American engines have, as it were, gradually crystallized into certain definite and fixed forms. Outside cylinders and inside frames are now universally used here, whereas on the Continent cylinders and frames are sometimes placed inside of the wheels and sometimes outside. The steam chests here are always placed on the outside and top of the cylinders; thus they are often placed on the side and inside the frames. Almost the only kind of pistons which seems to be used there is that made with solid heads, with simple grooves turned on the outside, into which steel, cast-iron or brass rings are sprung. Here the varieties of packing in use are numberless. For simplicity and cheapness, the European is certainly very much superior to ours. Here the only valve-gear now made is the shifting link-motion worked from eccentrics on the main axle; there the shifting link, the suspended link, the Allan or straight link, the Walschaert and several other kinds of valve-gear are used. Some of them are worked from eccentrics placed outside of the wheels, and in at least one engine we notice that the axle-bearings are outside of the wheels and then the eccentrics are placed next the bearings and a crank outside of them to which the connecting-rods are attached. Here all wheel-centres are made of cast iron; there, of wrought iron. In the tires for our truck wheels we are imitating Europeans, and steel tires are now much used here for that purpose. The springs in American engines are, if we except the Boston & Albany Railroad, always placed above the axles and frames. In Europe they are often below. Here they are, excepting in four-wheeled engines, always arranged with equalizing levers; there this is not always the case. The use of plate frames is universal in Europe, whereas in this country they are now never used.

In the construction of locomotive boilers there is also a very great difference in their practice. The steam dome is there always placed either about the middle or near the front end or smoke-box. The "Becker" pattern of boiler is also much used, especially in Germany and Austria. In this plan the outside of the fire-box instead of being arched is rectangular—that is, the top of what we call the wagon-top instead of being round is flat, and is raised somewhat

* Mr. Mason is now building an engine with this valve-gear.

above the barrel of the boiler. The corners are, however, rounded somewhat. The crown-sheet, instead of being stayed with crown-bars and braces, is supported by long stay-bolts screwed through the outside shell and the crown-sheet. Some of the engines which are to be built at the Grant Locomotive Works for a Russian road are to be made in this way. This is, we think, a very excellent plan, and is quite certain to be adopted in this country when its merits once become known. Shaking grates are, however, seldom shown in the illustrations of European engines; but grates very steeply inclined are still much used there. It is very singular that in Europe the exhaust steam almost universally is allowed to escape at the base of the smoke-stack instead of the bottom of the smoke-box as is the practice here. It will also be observed that there many of the smoke-stacks are made conical; that is, the base of the inside of the stack is smaller than the upper part. We have seen it stated somewhere that it is found that the steam blast is much more effective with this form than with a straight stack. We do not know, however, upon what the assertion was based, and would be glad to get some further information in reference thereto.

The differences in points of detail are almost numberless and are well worth study. The reasons for many of these differences would be very interesting if carefully examined, and we intend to return to the subject again. A very striking fact, however, is the much greater variety in the methods of construction adopted in Europe than is in use here. The reason for this we believe to be, singular as it may seem, partly political. The suppression or rather repression of individuality under republican governments has often been remarked. In this country perhaps no principle is more generally believed than that "the majority should rule." The result is that this axiom produces a kind of intellectual subserviency of the individual to the will of the majority, which thus to a very great extent becomes the standard of right and wrong. If therefore any new method of construction fails to be approved by a majority, it is abandoned. We will not undertake here to determine whether the suppression of individuality is a gain or a loss. It is quite certain that originality is very expensive when it exercises itself in the construction of locomotives or other railroad machinery, and that the Chinese virtue of uniformity has much merit and is often profitable when great ingenuity and skill would not be.

The Erie and Its Auditor.

Mr. S. H. Dunan, who resigned his office of Auditor of the Erie Railway on the 11th ult., and at that time made charges that the accounts of the company had been falsified in such a way as to show a favorable result of the management, has published a circumstantial account of the acts which he complains of. Briefly, it is to the effect that the President knew the accounts of the operations up to July, 1873, proved that the expenses were largely in excess of the receipts; that then Mr. Dunan consented to such a modification (in itself a falsification) of the accounts as would show earnings equal to the working expenses. At that time and until the 25th of August the Auditor says that Mr. Watson declared that no dividend should be declared. But after a board meeting on the 27th of August, at which Mr. S. L. M. Barlow, who held proxies for a majority of the stock, insisted that a dividend should be declared, the Third and Fourth Vice-Presidents were sent for, and after their visit letters from them were produced which formed the basis of entries which took \$1,123,000 from the expenses, and gave the amount necessary for dividends of 3½ per cent. on preferred and 1 per cent. on common stock. The basis of the change, as we understand, was that the road, on coming into the hands of the present management, was in extraordinarily bad condition, and that a "reparation account" was instituted to which was charged the expenses for those repairs which put the property into better condition than when it was received from the Gould management.

The result of this, Mr. Dunan says, was that more than \$3,300,000 of the proceeds of the \$8,000,000 convertible bonds were used in one year to pay working expenses and dividends.

The statement of expenditures on capital account from the proceeds of the \$8,000,000 loan published in London in February, when the new loan was put on the market, varied from the true statement, according to the ex-Auditor, as appears below:

	Company's statement.	True statement.
Cost of road and equipment.....	\$5,833,879 14	\$2,822,405 00
Improvement of branch roads.....	747,195 82	112,266 24
Purchase of coal lands.....	17,599 80	717,599 50
Total	\$7,299,074 46	\$3,652,270 76
Difference		\$3,646,803 70

Mr. Dunan closes his letter to Mr. Watson by saying: "I have shown, in my report to the Board of March 3, 1874, that there was a deficiency in the capital account for the fiscal year 1873 of \$3,677,911.16. The facts and figures therein given are incontrovertible. The books and accounts prove them conclusively. No mere assertion can alter or change them. The entries which have been made to change the true accounts into the false throw the books

out of balance and stand on their pages as a blot upon your name and mine."

Now all this has a bad look. It will not do to say or to prove that Mr. Dunan is not what he ought to be, or that he has used this statement for the purpose of affecting the stock market. He may have done all this with the basest motives; not his motives but the truthfulness of his statement is the main question. His charges are definite and cannot be met by a general denial.

No statement has yet been made by the company, President Watson having but just arrived from Europe; but very likely one will be made directly, and it will be awaited with great interest.

Whether the statement be true or false, it seems to us that the case is one which brings into prominence a grave defect in American railroad organization generally. Mr. Dunan, the Auditor of the Erie Company, like most or all similar officials of American railroad companies, was the appointee and direct servant of the administration of that company, holding his office at the pleasure of the President, or of the President and the Executive Committee of the Board. Of course, under such circumstances it is impossible for the accounting officer to be a check on the administration; and with this prevailing arrangement a railroad manager not only may do pretty much what he pleases with the road intrusted to him by its proprietors, but he practically audits his own accounts.

In England, the auditors (for there are more than one usually) are not only independent of the President, but of the Board itself, being chosen by a separate vote at the meeting at which the shareholders choose directors, and having independent authority. It is also the practice, we believe, to permit the minority, when there are parties among the shareholders, to name one of the auditors. It is true that the English auditor's duty is rather to verify accounts than to keep them, and that in many ways his position is not comparable to that of the American official. But the feature to which we desire to call attention is his independence of the administration. He forms a real check where our companies have none. It seems to us that a reform in this direction is desirable, and that our companies might well consider the propriety of making their auditing officers independent of the management whose accounts they audit, and of securing to any considerable minority of stockholders the right of naming one auditing officer with full authority to examine all accounts.

The Cleveland, Columbus, Cincinnati & Indianapolis Railway.

The report for 1873, a summary of which we published last week, is the more interesting at this time because of the change of the management made in the middle of the year, and parties among the stockholders, one in favor of and the other opposed to the present management. Originally the division was entirely on a question of policy, which concerned a lease to or consolidation with, or at least practical working as part of, the Atlantic & Great Western. The old management had a reputation for ability and success, as the present one certainly has. But we understand that there have been insinuations at least that the line has not been economically worked since the change. It certainly is hard to find any indications of any considerable change in either direction in the report for the year, which covers an equal time under each management. With an average mileage greater by 10 per cent., and an increased train mileage of 11 per cent., at an increased expenditure for working of 7.22 per cent., the gross earnings were increased 6.85 per cent. and the net earnings 6.15 per cent., and the surplus after paying interest charges 5% per cent. The average cost per train mile was 82 3/4 cents in 1872 and 78 1/4 cents in 1873, there being thus a considerable decrease (about 4 1/2 per cent.) in this unit of expense, which is probably the fairest one to take.

An extremely interesting table of the tonnage mileage, receipts, and receipt per ton per mile, for through and way and for eastward and westward freight is given in this report. By this it appears that 74 per cent. of the tonnage mileage and 64 per cent. of the receipts were from through freight, carried at an average price of 1.175 cents per ton per mile, while the average receipt from way freight was 1.899 cents per mile. Of this through freight 82 per cent. earning nearly 80 per cent. of the through freight earnings and 51 per cent. of the total freight earnings, at an average rate of 1.139 cents per mile, was east-bound; the through west-bound freight, at an average rate of 1.34 cents per mile, earning only 20 per cent. of the through freight earnings and only 13 1/2 per cent. of the total freight earnings. Of the way freight, 72 per cent. was east-bound, with earning 67 1/2 per cent. of the way freight earnings and 24 1/2 per cent. of the total freight earnings, at an average rate of 1.818 cents per ton per mile, the average rate for west-bound way freight being 2.093 cents. Of the total tonnage mileage, nearly 80 per cent. was east-bound, earning 75 per cent. of the total freight earnings, at an average rate of 1.295 cents per mile, the average rate on all west-bound freight being 1.611 cents per ton per mile, and on all freight 1.362 cents. This road's average rates appear to be a trifle lower than those of the Lake Shore even, and only higher than the unprofitable Philadelphia & Erie among all the lines of which we have reports. Situated as it is, running at an angle of nearly 45 degrees with the prevailing current of traffic, and crossed at short intervals by competing lines, many of which have shorter routes, it is compelled to accept lower than average rates, and is as successful only by reason of its low capital account, good management, and the prosperous and populous country on its route.

Record of New Railroad Construction.

This number of the RAILROAD GAZETTE has information of the laying of track on new railroads as follows:
Baltimore, Pittsburgh & Chicago.—Extended from Deshler westward 22 miles to a point within six miles of Defiance, O.
This makes a total of 303 miles of new railroad completed in the United States in 1874.

Contributions.

The Proposed Delaware River & Bound Brook Railroad—An Old Scheme Revised.

PHILADELPHIA, April 8, 1874.

TO THE EDITOR OF THE RAILROAD GAZETTE:

The "Delaware River & Bound Brook" item in the GAZETTE of 4th instant, to the effect that a company has been organized, under the free railroad law of New Jersey, to build a railroad from the New Jersey Central Railroad at or near Bound Brook, on the Raritan River, to the Delaware River at or near the mouth of Moore's Creek, below Lambertville, a distance of "about twenty-seven miles," is indicative of the resuscitation of an old project, or of a new project on old ground.

At irregular intervals, through long years of the past, efforts were made to compass the construction of a railroad between Philadelphia and New York, to divide the through traffic with the long reigning and legislatively absolute "Camden & Amboy" organization (now locked in the grasp of the Pennsylvania Central under lease), and meantime open for local traffic a new route northwest of Trenton, between the two great cities which command the commerce and manufactures of the nation.

When the North Pennsylvania Railroad was incorporated in 1852, it was the design of its originator that it should comprise a trunk line from Philadelphia northward via Bethlehem, Mauch Chunk, Pittston and Towanda to the Erie Railway at Waverly, on the New York State line, with a branch via Easton to and through the Delaware Water Gap to the Erie Railway at Port Jervis, thus occupying the Lehigh River Valley between Easton and White Haven, the Susquehanna River Valley between Pittston and Waverly, the Delaware River Valley between Easton and Port Jervis, from an eligible point near the butt end of the line (which at the outset was pushed down into the city to the docks in the center of the port), it seemed a logical sequence that, at some future time, somebody would consummate a connection via the North Pennsylvania with the city of New York.

If it be said that this North Pennsylvania Railroad scheme covered much ground, it may be said that most of it is now occupied by roads in operation, the occupation of the balance being simply a question of time.

With the exception of that from Solomon's Gap, near Wilkesbarre, the North Pennsylvania Railroad Company's line swooped eastward down the mountain into the Wyoming Valley at Pittston, whereas the Lehigh Railroad Company's line loops westward down the mountain, grade ninety-six feet in the mile, to Wilkesbarre (where the railroad grade is 1,180 feet below the summit), the last-named company occupying and using 153 miles of the ground originally occupied by the North Pennsylvania Railroad Company survey, as published official documents testify.

The late Charles F. Wells, of Athens, Bradford County, co-operated with the North Pennsylvania Railroad Company in 1853, and it was in large part in consequence of his representations and services, more than a dozen years afterward, that Lehigh Valley Railroad interest took possession of the Susquehanna Valley between Wilkesbarre and Waverly, and built a link of road 105 miles long, which combines strategy and profit. It was opened for through traffic the 13th September, 1869.

In a letter dated "Athens, August 14, 1868," to Mr. T. S. Fernon, Mr. C. F. Wells says:

"Your original design of building the North Pennsylvania Railroad here had the misfortune of being conceived and planned by a railroad mind full twenty years in advance of yours and our people."

Mr. Wells, however, lived to see his own beautiful North Branch Valley traversed by the locomotive, and to enjoy the appreciation of persons cognizant of his diplomacy which ended in success. He died in October, 1872.

Returning to the Delaware River & Bound Brook item, the correspondence which follows shows that the project of a railroad between Philadelphia and New York across the Delaware River northwest of Trenton, has been in incubation long enough for hatching out.

In the fifty miles of distance between the railroad bridge at Trenton and the lower of the two railroad bridges at Easton, there are eleven common road toll bridges across the Delaware River—an evidence of intercommunication across the river boundary between Pennsylvania and New Jersey. Surely it is time the Delaware River was spanned by a railroad bridge somewhere in that long stretch of town-dotted and densely-peopled territory.

TRENTON, N. J., April 22, 1873.

Thomas S. Fernon, Esq., President Phila., Easton & Water Gap R. R. Co.:

DEAR SIR: We, the undersigned, being about to be associated with three other gentlemen residing in the State of New Jersey in a corporate capacity, according to the Legislative acts of our State passed in 1849-'52, in a business which will require and result in a speedy construction of a railroad on our part, on a direct line from the Delaware River at or near Lambertville to some point on the Hudson River opposite the city of New York, and learning from the latter clause of the first section of our charter that your board are authorized to construct "one or more branch roads with any railroad or other public improvement in the State of New Jersey," we embrace this opportunity of asking you whether, if we will

* This name, originally chosen for a diplomatic purpose, was changed to "The North Pennsylvania Railroad Company" by the board of directors on the 8d of October, 1869, under an act of the Legislature.

run a road as above contemplated to the above specified point or points on the Delaware, you will meet us with a branch of your road from the city of Philadelphia, to form one continuous line of communication for the mutual benefit of both companies and the public good?

You will respond by first mail.

Respectfully yours,

CHARLES MOORE.

DEWEY WHITNEY.

OFFICE OF THE PHILA., EASTON & WATER GAP R. R. Co., PHILADELPHIA, April 23, 1853.

DEAR SIR: In answer to your joint letter bearing date Trenton, N. J., April 22, 1853, I have to say that the Philadelphia, Easton & Water Gap Railroad Company will be ready at any fitting time to supply, by a branch road from their main line, as authorized and contemplated by their charter, the Pennsylvania link in a new and direct continuous railroad route between the cities of Philadelphia and New York, to cross the Delaware River at an eligible point at or near Lambertville.

Respectfully yours,

THOMAS S. FERNON.

CHARLES MOORE, Esq.

DEWEY WHITNEY, M. D.

The city termini being provided, the middle link will cost little for right of way, on ground available for cheap construction. Consult a map.

Passes for Master Mechanics.

CINCINNATI, O., April 13, 1874.

TO THE EDITOR OF THE RAILROAD GAZETTE:

In the GAZETTE of March 28, in your article on the "Master Mechanics and the Convention," you express fears that, from information received, the attendance at the annual meeting will not be large, on account of the abolishing of the pass system. Reference is supposed to be made here to the action of the Superintendents' Association in that matter; but the writer does not understand that any resolution has ever been adopted by that body that was intended to prevent the giving of free passes to railroad master mechanics or master car builders who might desire to pass over any line for the purpose of attending the annual meetings of the respective associations; and he has yet to hear of the first instance, where proper application has been made, where a pass has been refused; but, on the contrary, there is a general expression in favor of these associations among our leading railroad officers and prominent members of the Superintendents' Association. Your correspondent, feeling sure of this being the case and desiring to prevent any wrong impression from the article referred to, has written to a large number of railroad officers on this subject, and the replies thus far, without exception, have been in favor of the associations, and the insuring of free passes to all members desiring to attend the annual meetings.

As the information contained in these communications was intended for the benefit of the master mechanics, two of these are inclosed for publication. Both of these gentlemen are well-known railroad men, and are prominent officers of the Superintendents' Association, Mr. Fink being the Vice-President and Mr. Paine the Secretary and Treasurer.

J. H. SETCHEL,

Secretary Master Mechanics' Association.

Louisville & Nashville and Great Southern Railroad, Office of Vice-President and General Superintendent, LOUISVILLE, Ky., April 1, 1874.

J. H. SETCHEL, Esq., Sec'y, Cincinnati, O.:

DEAR SIR—Yours of 8th has been received. I will take great pleasure in passing the master mechanics over our road upon their making application to me.

I look upon your Association as the most useful to railroads that has yet been inaugurated, and I shall be glad at all times to do anything in my power to contribute to its success.

Yours, very truly, ALBERT FINK, V. P. and G. Supt.

The Lake Shore and Michigan Southern Railway Co., CLEVELAND, O., April 10, 1874.

J. H. SETCHEL, Esq., Sec'y Am. Railway M. M. Association, Cincinnati, O.:

SIR—Yours of the 8th received. We shall be very glad to have the master mechanics make use of our line in going to and from the annual convention at Chicago, and will forward passes to any who may apply, upon receipt of the applications. We believe the previous conventions have been very useful, and that there is promise of still greater usefulness.

Very truly yours,

CHARLES PAINE.

Perpendicularity of Leveling Rods.

ARCADE, Wyoming Co., New York, April 8, 1874.

TO THE EDITOR OF THE RAILROAD GAZETTE:

I notice several articles have of late appeared in the GAZETTE on "Eliminating the Error in Leveling from Want of Perpendicularity of the Rod."

In order to obtain a correct reading the rod should be kept still. For accurate leveling I use a block to apply to the corner of the rod, having a short string and plumb bob attached, by which the rod-man keeps the rod plumb.

H. B. ALLEN.

General Railroad News.

ELECTIONS AND APPOINTMENTS.

—At a meeting of the stockholders of the Baltimore, Pittsburgh & Chicago Railway Company, Indiana Division, at Auburn, Ind., April 10, the following directors were elected: A. P. Edgerton, Fort Wayne, Ind.; W. C. Quincy, Columbus, O.; John Gardner, Norwalk, O.; T. H. Garret, William Keyser, John K. Cowen, W. H. Hams, Baltimore. The board elected W. C. Quincy, President; W. H. Hams, Vice-President; James L. Randolph, Chief Engineer.

—At the annual meeting of the Baltimore, Pittsburgh & Chicago Railway Company, Ohio Division, in Columbus, O., April 6, the following directors were elected: W. C. Quincy, Wm. Keyser, John K. Cowen, George R. Dennis, Wm. Holgate and A. D. Smith. W. C. Quincy was elected President, Wm. Wing, Secretary and Treasurer, and James L. Randolph, Chief Engineer.

—The Winona Republican, of April 8, says: "It is rumored

on pretty good authority that Mr. Sherborn Sanborn, formerly General Agent of the Chicago & Northwestern at Milwaukee, has been appointed Superintendent of the Winona & St. Peter road.

At the annual meeting of the Chicago & Alton Railroad Company in Chicago, April 6, T. B. Blackstone, John B. Drake and D. Willis James, the three directors whose terms expire, were re-elected.

At the annual meeting of the Joliet & Chicago Railroad Company, April 6, John Crerar, T. B. Blackstone, John B. Drake, John McGregor Adams, and D. Willis James were elected directors. The road is leased by the Chicago & Alton.

At the annual meeting of the Mississippi River Bridge Company, April 6, T. B. Blackstone, H. V. P. Black, J. J. Mitchell, J. B. Drake and George Straut were elected directors. This is the company which owns the Louisiana Bridge.

At the annual meeting of the St. Louis, Jacksonville & Chicago Railroad Company, April 6, the following directors were chosen: John Crerar, George Straut, N. W. Green, Charles D. Hedges, L. E. Worcester, Josiah Sawyer. The road is leased to the Chicago & Alton Company.

At the annual meeting of the State Line & Missouri River Railroad Company, at Osborn, Mo., March 25, the following directors were chosen: J. M. Walker, A. T. Hall, William B. Strong, E. R. Wadsworth, Robert Harris, Chicago, Ill.; C. E. Perkins, Burlington, Ia.; S. D. Mallory, James D. Wright, Charleston, Ia.; Joseph Truax, Alton, Ia. The six first named are officers of the Chicago, Burlington & Quincy.

At the adjourned annual meeting of the Lewiston & Auburn Railroad Company, J. G. Osburn, E. F. Davis, H. B. Bartlett, G. H. Pillsbury, M. T. Ludden, E. L. Wood, J. S. Randall, E. A. Little and S. M. Jordan were chosen directors.

Mr. John Morrill, late of the Boston & Maine, has been appointed Roadmaster of the Portland & Rochester Railroad.

Mr. Thomas Holt, Chief Engineer of the Maine Central Railroad, has been appointed Chief Engineer of the Eastern Railroad also.

Mr. C. B. Peck, late Acting Superintendent of the Leavenworth, Lawrence & Galveston Railroad, will continue to act as General Freight and Ticket Agent, with headquarters at Lawrence, Kan. Mr. J. L. Barnes succeeds Capt. J. S. Ransom as Train Master, with office at Kansas City, Mo.

Mr. John Loyer has been appointed Master Mechanic of the Boston, Barre & Gardner Railroad.

The officers of the Pittsburgh & Western Refrigerator Company now are: President, William Mullins, Pittsburgh, Pa.; R. C. Meldrum, General Western Agent, Chicago; A. F. Nafis, Eastern Agent, Jersey City. The company's business is the transportation of perishable freight between Chicago and New York.

At the annual meeting of the Carondelet Transfer Ferry Company in St. Louis, April 3, D. R. Garrison was chosen President, and C. R. Garrison, Secretary and Treasurer.

Col. C. T. Pollard has been appointed Receiver of the Western Railroad of Alabama in a suit brought by the bondholders. He is President of the company.

At the annual meeting of the Detroit, Lansing & Lake Michigan Railroad Company in Detroit, April 7, the following directors were chosen: James F. Joy, Detroit; John W. Brooks, John A. Burnham, H. Hummel, Charles Merriam, George O. Shattuck, Nathaniel Thayer, Nathaniel J. Hayer, Jr., W. F. Weld, Chas. L. Young, Boston; Benjamin S. Rotch, New Bedford, Mass.

The stockholders of the Nevada County Railroad Company have organized by the election of the following board of directors: T. W. Sigourney, R. W. Talley, N. Searles, Nevada City, Cal.; William Watt, John Coleman, Edward Coleman, J. A. Lakeman, Grass Valley, Cal. The board subsequently elected John C. Coleman, President; F. G. Beatty, Vice-President, and George Fletcher, Secretary.

At the annual meeting of the Montreal, Chambly & Sorel Railway Company in Montreal, April 1, the following directors were elected: Felix Geoffron, Vercheres, Quebec; S. T. Willett, Chambly, Que.; Charles Gill, Sorel, Que.; Hugh Mathewson, Montreal; N. A. Smith, John C. Baker, Stanbridge, Que.; S. R. Whitman, Frelighsburg, Que. At a subsequent meeting of the directors the following were elected officers: Felix Geoffron, President; Samuel T. Willett, Vice-President; N. A. Smith, Secretary; James Baylis, Treasurer.

Mr. W. D. Chiple, Superintendent of the North & South Railroad of Georgia, has resigned to accept an appointment as Eastern and Southern Passenger Agent of the Baltimore & Ohio Railroad.

Mr. J. H. Raymond, late Secretary of the Illinois Railroad Commission, has been appointed Secretary of the Western Railroad Association, whose headquarters are in Chicago. Mr. George Willard, who has been connected with this Association since its organization, and was Secretary and Treasurer until this appointment, remains Treasurer of the Association.

TRAFFIC AND EARNINGS.

The anthracite coal tonnage of the lines given for the three months ending March 28 was as follows:

	1874.	1873.	Inc. or Dec.	P. c. of Inc. or Dec.
Del., Lack. & Western—				
Northward.....	133,155	154,103	Dec. 20,948	23%
Southward.....	394,907	477,580	Dec. 82,673	21%
Total.....	528,062	631,683	Dec. 103,621	16%

	1874.	1873.	Inc. or Dec.	P. c. of Inc. or Dec.
Central of New Jersey, Lehigh & Susquehanna Division.....	294,187	464,414	Dec. 170,227	31%
Delaware & Hudson.....	495,849	630,440	Dec. 134,591	21%
Pa. Coal Co., by Erie Ry.....	241,402	182,749	Inc. 58,653	32%
Northern Central—				
Shamokin Div.....	88,897	117,763	Dec. 28,866	24%
Totals.....	1,048,307	2,027,075	Dec. 978,768	18%

The anthracite coal tonnage of the lines given (whose year begins December 1) for the four months ending March 28 was as follows:

	1874.	1873.	Inc. or Dec.	P. c. of Inc. or Dec.
Philadelphia & Reading.....	1,332,273	1,377,195	Dec. 44,922	3%
Schenectady Canal.....	30,687	11,011	Inc. 19,676	23%
Lehigh Valley.....	1,066,928	1,039,154	Inc. 27,774	2%
Pa. & N. Y. (anthracite).....	191,019	177,951	Inc. 13,068	7%
Totals.....	2,620,907	2,605,311	Inc. 15,596	1%

The bituminous coal tonnage of the Pa. & N. Y. was.....

	1874.	1873.	Inc. or Dec.	P. c. of Inc. or Dec.
Pa. & N. Y. was.....	58,190	75,779	Dec. 17,589	23%

The earnings of the Midland Railway of Canada for the two months ending February 28 were: 1874, \$28,952; 1873, \$24,037; increase, \$4,915, or 20% per cent.

The earnings of the Intercolonial Railway for January were: 1874, \$58,352; 1873, \$50,949; increase, \$7,403, or 14% per cent. The earnings per mile were: 1874, \$217; 1873, \$195.

The earnings of the Great Western Railway of Canada for the week ending March 20 were: 1874, \$23,497; 1873, \$24,275; decrease, \$778, or 3% per cent.

The earnings of the Grand Trunk Railway for the week ending March 14 were: 1874, \$39,800; 1873, \$36,000; increase,

\$3,800, or 10% per cent. For the week ending March 21 the earnings were: 1874, \$38,700; 1873, \$36,500; increase, \$2,200, or 6 per cent.

The earnings of the Central Pacific Railroad for March were: 1874, \$867,686; 1873, \$939,778; 1872, \$875,763; decrease, 1874 from 1873, \$72,112, or 7% per cent.; decrease, 1874 from 1872, \$8,097, or 0% per cent. For the three months ending March 31 the earnings were: 1874, \$2,510,224; 1873, \$2,521,061; 1872, \$2,030,522; decrease, 1874 from 1873, \$10,837, or 0% per cent.; increase, 1874 over 1872, \$479,702, or 23 per cent.

The Bingham Canon Railroad carried during March 4,310 tons of freight.

The earnings of the Milwaukee & St. Paul Railway for the first week in April were: 1874, \$151,000; 1873, \$125,700; increase, \$25,300, or 20% per cent.

The following companies have thus far reported earnings for March:

	1874.	1873.	Inc. or Dec.	P. c. of Inc. or Dec.
Atlantic & Great Western.....	\$402,317	\$409,930	Dec. 7,613	4%
Burl. Cedar Rapids & Mnnh.....	88,016	85,511	Inc. 2,505	3%
Central Pacific.....	869,666	939,778	Dec. 70,112	7%
Cleveland, Col., Cin. & Ind.....	318,976	441,386	Dec. 122,410	2%
Chicago & Northwestern.....	1,039,986	967,258	Inc. 72,728	7%
Erie.....	1,413,221	1,028,742	Inc. 384,479	33%
Illino's Central.....	567,514	660,759	Dec. 93,245	14%
Indianap., Bloom. & Western.....	151,185	112,569	Inc. 38,617	34%
Kansas Pacific.....	245,774	309,719	Dec. 63,945	18%
Marquette & Mich.....	161,031	180,467	Dec. 19,436	10%
Milwaukee & St. Paul.....	576,260	555,287	Inc. 20,973	3%
Misouri, Kansas & Texas.....	258,600	266,719	Dec. 8,119	3%
Mobile & Ohio.....	174,968	290,127	Dec. 115,159	32%
Ohio & Mississippi.....	297,613	300,993	Dec. 3,380	1%
St. Louis, Alton & Terre Haute, main line.....	104,193	122,299	Dec. 18,106	14%
St. Louis, Alton & Terre Haute, branches.....	44,492	53,430	Dec. 8,938	16%
St. Louis, Kan. City & N.W.....	201,313	229,925	Dec. 28,612	12%
Toledo, Peoria & Warsaw.....	98,032	102,491	Dec. 4,459	4%
Toledo, Wabash & Western.....	404,699	471,301	Dec. 66,602	14%

The earnings of the Catawissa Railroad for the year ending December 31 were: 1873, \$713,012; 1872, \$677,526; increase, \$35,486, or 5% per cent. Earnings per mile were: 1873, \$7,060; 1872, \$6,708.

PERSONAL.

Mr. David Connell has resigned his position as General Superintendent of the Wilmington & Western Railroad and accepted a position in the Edgemoor Iron Works. The change takes place May 1.

Major Judson B. Gayle, Superintendent of Machinery of the Raleigh & Gaston Railroad, died at his residence in Raleigh, N. C., April 7, of consumption. He was 48 years old.

Col. William Phillips, President of the Allegheny Valley Railroad Company and a leading iron manufacturer of Pittsburgh, died at his residence in that city on the morning of the 14th inst.

Sir Daniel Goode, M. P., Chairman of the Great Western Railway Company of England, was Locomotive Superintendent of that road from 1838 to 1865.

The Boston Advertiser is authorized to say that the reports that Mr. Charles F. Hatch would shortly retire from his position as General Manager of the Eastern and Maine Central roads are entirely without foundation.

CHICAGO RAILROAD NEWS.

Western Live Stock Rates.

Following is the tariff per car load on live stock agreed upon by the officials of the Western, Southwestern and Southern roads, at their recent meeting in St. Louis:

FROM	TO St. Louis.	TO Chicago.	FROM	TO St. Louis.	TO Chicago.
Denison, Texas.....	\$100	\$130	Olathe, Kan.....	\$52	\$82
Red River, I. T.....	100	130	Coffeyville, Kan.....	55	85
Caddo, I. T.....	100	130	Independence, Kan.....	55	85
Arkala, I. T.....	100	130	Chanute, Kan.....	55	85
Muskogee, I. T.....	80	110	Humboldt, Kan.....	51	81
Gibson, I. T.....	70	105	Lawrence, Kan.....	52	82
Vinita, I. T.....	65	95	Atchison, Kan.....	40	70
Prairie City, I. T.....	65	95	Leavenworth, Kan.....	40	70
Chetopa, Kan.....	65	95	Kansas City, Mo.....	40	70
Owego, Kan.....	65	95	Sedalia, Mo.....	40	70
Onaga, Kan.....	65	95	Boonville, Mo.....	40	70
Parsons, Kan.....	65	95	Jefferson City.....	30	50
Seneca, Mo.....	65	95	St. Joseph, Mo.....	40	70
Baxter Spring, Kan.....	65	95	Chillicothe, Mo.....	45	75
Columbus, Kan.....	65	95	Mexico, Mo.....	30	40
Fort Scott, Kan.....	65	95	Moberly, Mo.....	30	45
Paola, Kan.....	58	88	Cameron, Mo.....	30	45

The rate to East St. Louis, East Louisiana, East Hannibal and Quincy is \$5 per car more than to St. Louis. The rates went into effect on the 6th inst.

Illinois Central.

The Land Department reports sales for March of 2,597.91 acres construction lands for \$18,686.18 and 160 acres free lands for \$2,240, a total of 2,757.91 ac. for \$20,926.18. Cash collections for the month amounted to \$38,745.67.

The Traffic Department reports earnings as follows for March:

	In Illinois.	In Iowa.	Total.
Freight.....	427,540 00	\$70,712 00	\$498,252 00
Passengers.....	102,884 12	42,177 85	145,061 97
Mails.....	6,375 01	3,059 24	9,434 25
Other sources.....	64,625 00	2,680 76	67,305 76

Total March, 1874.....	\$448,924 12	\$118,629 85	\$567,553 97
Actual earnings March, 1873.....	532,937 95	127,821 44	660,759 39

This is a decrease of 15% per cent. in the Illinois earnings, of 7-16 per cent. in the Iowa earnings and of 14% per cent. in the total earnings.

A dispatch from Washington to Dubuque states that in the great elevator case, the United States Supreme Court has affirmed the judgment of \$83,000 against the company and in favor of Richmond & Jackson. This, it is said, virtually settles all the cases, including the suit for \$300,000 recently decided against the company by the Circuit Court at Dubuque.

Chicago & Pacific.

Work has been resumed on the grading at Port Byron, Ill., and the contractors expect to have the whole line from Elgin west to Byron ready for the rails, except a short section of heavy work near Elgin, very soon. At the Rock River bridge, another pier is to be built to carry the bridge 160 feet across the flats east of the river, instead of filling in.

Chicago & Great Western.

This company, which was organized some two years ago by

the name of La Salle & Chicago to build a road from Chicago to La Salle, lately made some surveys of the line in the city of Chicago upon which it was authorized to lay its track, whereupon some of the property-owners on the line made application for an injunction. The bill filed alleges that the company has done no work on its projected road, that the organization is only nominal, and that the company intends to lay rails in the city with some object not connected with the construction of the road.

Lake Shipments to Europe.

The Merchants' Lake and River Steamship Line has twelve steamers ready to ply between Chicago and Montreal, with a new boat building. These vessels connect with steamer lines from Montreal to Liverpool, Glasgow and other European ports, so that there is but one transshipment, and that an easy one, between Chicago and Europe. Through bills of lading are given, and goods go into the bonded warehouse on arrival.

OLD AND NEW ROADS.

New York & New England.

At a meeting of the stockholders in Boston, April 7, it was voted that a committee of five be chosen and requested to confer with the trustees in possession, and, after investigating the present condition and wants of the company, to report at an adjourned meeting of the corporation, with such recommendation as may seem to them proper with a view to securing the immediate possession and completion of its entire property. In accordance with the vote, the following persons were chosen: Hon. Charles R. Train, Dr. J. C. Ayer, Henry Saltonstall, Eben B. Phillips and George M. Rice. The chairman was authorized to fill any vacancies which may occur. The meeting adjourned until April 21.

Parker & Karna City.

This road was formally opened for business April 8. It is 10 miles long from Parker City, Pa., southwest to Karna City, through the new Butler County oil district. It is of 3-feet gauge.

Northern Pacific.

A meeting of the first-mortgage bondholders is called, by order of the trustees, to be held at the company's office, No. 23 Fifth avenue, New York, May 21, at 11 a. m., for the purpose of acting on the appointment of a trustee or trustees under the mortgage to fill any vacancies which may exist in the trust.

Washington, Cincinnati & St. Louis.

Additional men are to be put on the grading, and two more surveying parties put in the field.

Petersburg.

The men employed in the repair shops at Petersburg, Va., struck recently to obtain their back pay. It is stated that some of them had not been paid for six months past.

Boston, Clinton & Fitchburg.

A station building to cost \$100,000 is to be built in Fitchburg, Mass., this year.

Eastern.

At a special meeting in Boston, April 8, the stockholders voted to ratify and confirm the issue of \$1,000,000 (\$200,000) sterling bonds already made, and also to authorize a further issue of \$2,000,000 (\$400,000) sterling bonds, having 20 years to run, and bearing 6 per cent. interest. Several stockholders took occasion to express dissatisfaction with the present management, but the issue of bonds was ordered by a unanimous vote of the stock present.

Central Vermont.

This company has made arrangements to run Pullman cars between Boston and Chicago over its lines and by way of Montreal and the Grand Trunk Railway. The cars are to begin running about May 1.

Shenandoah Valley.

The directors at their recent meeting in Charlestown, W. Va., resolved to arrange for the early resumption of work. The company will endeavor at least to have iron laid on that part of the road which is already graded.

Springfield, Athol & Northeastern.

Surveys have been made for a branch line 1 1/2 miles long to Chicopee Falls, Mass. It is said that the branch will be built this season.

Easton & Amboy.

Work has been resumed on the grading all along the line and is being pushed forward, especially on the eastern end, between Bound Brook, N. J., and Perth Amboy. Work on the great tunnel through Musconetcong Mountain, near Paterson, is progressing as fast as the nature of the work will permit.

Grain Deliveries at New York.

In addition to the large elevator which the New York Central & Hudson River Company is preparing to build in New York, it is stated that the Erie Company is preparing plans for an elevator, to be put up on some part of its property in Jersey City. The Pennsylvania Railroad Company is also considering the question of building one of large capacity, the location of which is not yet decided on, though it will most probably be on the Harsimus Cove property, where the new freight depot is being built.

Selma, Marion & Memphis.

The County Court of Shelby County, Tenn., has ordered suit to be commenced on the bond given by this company to secure the faithful expenditure of the money voted by the county in aid of the road. It is alleged that \$95,000 has been expended in direct violation of the conditions of the subscription.

Edgefield & Olarksville.

This company asks the County Court of Davidson County, Tenn., to vote to it the \$150,000 stock of the Louisville & Nashville Company now held by the county.

Boston & Albany.

The men in the Springfield shops are working full time, but at a reduction of 10 per cent. in wages. The force employed is about nine-tenths of the usual number.

Meetings.

The following companies will hold their annual meetings at the times and places given:

Central Railroad Company of New Jersey at the office in Jersey City, May 8, at 12 m. Transfer books are closed from April 17 to May 9.

Delaware & Hudson Canal Company at the office No. 71 Broadway, New York, May 12, at 12 m. Transfer books will be closed from April 30 to May 13.

Seaboard & Roanoke Railroad Company at the office in Portsmouth, Va., April 23, at 1 p. m.

Delaware, Lackawanna & Western—Morris & Essex Division.

On the eastern end of the new tunnel through Bergen Hill the heading has advanced about fifteen feet. Shaft No. 1 has been sunk seventy-one feet, just to the roof of the tunnel.

Shaft No. 2 has been sunk about fifty feet, No. 3 about forty feet, and Nos. 5 and 6 are down to the rock, which is here about fifteen feet under the surface. At the west end the rock has been stripped of its covering of earth and the heading has been commenced. A commencement has also been made on the heavy cutting west of the tunnel. The trouble between the contractor and his men has been adjusted and a full force is now at work.

Dividends.

The Baltimore & Ohio Railroad Company has declared a semi-annual dividend of 5 per cent., on the stock of the Main Stem, payable May 1. A semi-annual dividend of 5 per cent. on the stock of the Washington Branch was also declared and became payable April 17.

Jacksonville, Northwestern & Southeastern.

Work has been begun on the extension from Virden, Ill., southeast to Raymond on the St. Louis Division of the Toledo, Wabash & Western. A correspondent informs us that the company, having been unable to sell its bonds, has contracted for some of the grading with farmers on the line, who are to be paid in transportation when the road is completed. Mr. L. S. Olmstead, of Jacksonville, Ill., is Chief Engineer.

Cincinnati Southern.

Work on the grading of divisions D and E, from Shelby City, Ky., to Chitwood is progressing steadily except on a few sections which were thrown up by the contractors, including the masonry of the Cumberland Bridge. The letting of contracts on divisions F and G has been postponed till April 8. Each division comprises about 40 miles.

Cumberland & Ohio.

Mr. E. F. Falconnet, the Chief Engineer, informs us that this company is about to let 40 miles of grading and masonry, between Eminence and Greensburg and between Glasgow and Scottville, Ky. There will then remain only 60 miles to be let of the whole line between Eminence, Ky., and Gallatin, Tenn., about 200 miles. The company expects to lay track between Lebanon and Greensburg, Ky., in the course of next summer. Eminence is a station on the Louisville & Lexington road about 45 miles east of Louisville, and the route of the line is southeastward from that place nearly parallel with the Louisville & Nashville and generally 20 miles or more east of it.

Indianapolis, Cincinnati & Lafayette.

Chicago papers state that arrangements are being made by this company and the Pittsburgh, Cincinnati & St. Louis to pool the earnings of the two roads on all business between Chicago and Cincinnati. If the arrangement is completed a rise in rates is probable.

Texas, Mississippi River & Northwestern.

On this company's Chicot & Pine Bluff line some 20 miles is rendered useless by the washing out of portions of the road by high water. The breaks cannot be repaired until the water subsides. The mail is carried over this part of the road in boats. On the Monticello line 30 miles of track is under water, much of which will have to be rebuilt.

North Wisconsin.

Surveying parties have been put in the field to locate the line from the terminus of the road to Ashland. It is not probable that any material change will be made in the line already surveyed.

The Detroit Bridge Question.

The Detroit Board of Trade called a public meeting of delegates from all parts of the State to consider the question of bridging the Detroit River. Resolutions in favor of a bridge were carried; but there was a strong opposition to them. The vessel-owners of Detroit have also formed an association for the protection of their interests and to oppose the erection of a bridge by all lawful means.

Leavenworth, Atchison & Northwestern.

The County Commissioners have been asked to enforce the agreement under which aid was voted to this road by Leavenworth, Kan., on condition that that city should be the southern terminus of the road and that the machine shops, etc., of the road should be built there. The road is now leased to the Missouri Pacific.

Northern Central.

The adjourned annual meeting was held in Baltimore, April 9. The President reported that the Pennsylvania Railroad Company had made a definite offer to lease the road at a rental equivalent to 6 per cent. on the stock, and the interest on the funded debt. This proposition was rejected with very little discussion. It was then resolved to appoint a committee of five stockholders, not connected with the management of either company, to examine into the company's affairs and to conduct any further negotiations with the Pennsylvania Railroad Company. The members of this committee are John Hulme and H. C. Borte of Philadelphia, Lambert Gittings, M. B. Greensfelder and J. H. Williams of Baltimore.

The stockholders voted to authorize an issue of \$10,000,000 consolidated mortgage bonds, \$6,000,000 to be laid aside to exchange for outstanding bonds as they mature, and \$4,000,000 to be used to extinguish the floating debt and for new construction and equipment.

All further business, including the election of directors, was postponed to another meeting, to be held at the call of the committee of stockholders.

Of the 116,838 shares of stock, it is stated that the Pennsylvania Railroad Company owns 48,420.

Monterey & Salinas Valley.

The preliminary surveys have been completed and the engineers report that there will be very little heavy work on the line. The length of the line from Salinas City, Cal., west to Monterey will be 18 miles.

Alabama & Chattanooga.

The receivers have found it necessary to reduce the train service to three trains per week each way, and the new schedule went into effect April 13.

Central, of Georgia.

Some 50 of the train hands were recently discharged at Macon, Ga., and both freight and passenger business is reported very light.

Louisiana Southern.

Natchitoches, La., with other towns and parishes along the proposed line, is to be asked to vote aid to this company. The company promises to begin work under the new organization in a short time.

South & North Alabama.

A preliminary injunction has been granted by the Chancery Court to restrain the collection of the special tax levied to pay the interest on the bonds issued by Montgomery, Ala., in aid of this road.

New Orleans, Mobile & Texas.

The Louisiana Supreme Court rendered a decision April 6 regarding bonds issued by the State to the New Orleans, Mobile & Texas Railroad, under the act of 1871. The Court did not pass directly on the validity of the bonds, but intimated that if the allegations made by the State were correct the bonds would be void, and remanded the case for further proof.

As the fact that the road has not been finished as required by the act is well known, there is very little doubt as to the final decision of the Court.

Old Colony.

It is stated that the Old Colony Steamboat Company, which is substantially owned by the Old Colony Railroad Company, has made arrangements to purchase the boats and other property of the Narragansett Steamship Company.

Baltimore & Ohio.

It is reported that negotiations are on foot between this and the Pennsylvania Railroad Company for a settlement of the difficulties between them. The basis of negotiation is said to be that the Pennsylvania Railroad Company will agree to haul two Baltimore & Ohio Washington trains through to New York daily, provided the latter will agree to cease using the new East Alexandria Branch and will run its trains to Alexandria over the Alexandria & Washington road as heretofore.

New York Central & Hudson River.

It has been reported in New York that a movement was on foot on the part of certain English capitalists to secure a controlling interest in this company. These reports do not appear to come from any reliable source.

The contract for laying the new freight tracks around Syracuse has been let to George B. Phelps & Co., of Watertown, N. Y., who also have the contract from Oneida to Syracuse.

Union Pacific.

The Committee on Pacific Railroad of the House of Representatives has authorized one of its members to report a bill requiring this company to operate the bridge across the Missouri River at Omaha as a part of its continuous line of road. This bill is designed to put a stop to the present extra charges for freight and passengers exacted for transferring them across the river by this bridge. Ten dollars per car is now charged for bridge tolls, and passengers are compelled to change cars. The bill, in order to protect holders of the bridge bonds, provides that the Union Pacific Railroad Company shall pay the interest on them, and shall also set apart annually an amount equal to 4 per cent. of the amount of the bridge bonds as a sinking fund for their redemption at maturity.

Mr. Wardell, late Manager of the Wyoming Coal Company, has brought suit against the Union Pacific Company and others in the courts at Omaha, Neb., to recover a large amount claimed to be due the coal company's stockholders. The Union Pacific Company has taken possession of all the mines and property, claiming that they own the largest share of the stock, and will hereafter run the mine in the interests of the road.

The corporators of the proposed railroad from Nevada City, Cal., to Colfax have organized the company by this name. Over \$125,000 in subscriptions to the stock have been secured. The road is to be of 3-foot gauge.

Baltimore, Chesapeake & Delaware Bay.

The contractor for the grading from Queenstown, Md., to Harrington, Del., is Mr. Thomas Costigan, of Georgetown, Del. The work has been already begun, and the necessary iron, three engines and some cars have been contracted for. The work is to be pushed forward.

Baltimore, Pittsburgh & Chicago.

At the annual meeting of the stockholders of the Indiana Division it was stated that the work is being pushed forward and track-laying has been commenced. It is expected that the whole line will be finished the present season. It was voted to accept the lease of the Illinois Division.

The officers of the Ohio Division, at the annual meeting of that company, reported that the track was laid within six miles of Defiance, O., or 22 miles west of the late terminus at Dasher. The whole line through Ohio is to be finished the present year.

St. Louis & Iron Mountain.

At the special meetings of the St. Louis & Iron Mountain, Arkansas Branch, and Cairo, Arkansas & Texas companies in St. Louis, April 11, the stockholders voted to ratify the agreement of consolidation of the three companies. The consolidation takes effect at once, but is only preliminary to the further consolidation with the Cairo & Fulton Company, which the stockholders are to vote upon shortly. The name of the company still remains St. Louis & Iron Mountain.

Chicago & Southern.

A company by this name has filed articles of incorporation with the Secretary of State of Illinois. The road is to run from Chicago southward to some point on the Chicago, Danville & Vincennes. The capital stock is to be \$250,000.

Wheeling & Lake Erie.

A mortgage has been executed to the Farmers' Loan and Trust Company of New York, as trustee, to secure the proposed issue of \$5,800,000 in bonds. These bonds are to be 7 per cent. gold bonds having 30 years to run from May 1, 1874, and are convertible into stock.

North Carolina.

The special meeting of the stockholders to vote on the acceptance of the consolidation act passed by the last Legislature was to be held in Salisbury, N. C., April 16. The act, a summary of which was given some weeks since, provides for a consolidation of the North Carolina, Western North Carolina and Atlantic & North Carolina companies, and the completion of the road west to the Tennessee line.

Western, of Alabama.

Col. C. T. Pollard (President of the company) has been appointed Receiver of this road in a suit brought by the bondholders. No change has been made in the immediate management of the road. The proceedings in court look towards a foreclosure of the mortgage and a sale of the road.

The road runs from Selma, Ala., east to Montgomery and thence east by north to West Point, 138 miles, with a branch 28 miles long from Opelika east to Columbus. It is a section of the most direct route from Savannah to the West.

St. Paul & Sioux City.

Since March 16, this company has been carrying seed grain and potatoes, flax seed, garden seed, fruit and forest trees, shrubs and cuttings to settlers on the line of its road between St. James, Minn., and Seney at half tariff rates, in less than car-loads. The circular from the company giving notice of this reduction announces that these special rates must cease May 4, as under the new railroad law, which goes into operation May 5, they are unjust discriminations and are prohibited.

Minnesota Railroad Commission.

The new Board of Railroad Commissioners met in St. Paul, March 31, and organized. Their first official action will be to investigate the charges of abuses and discrimination made against the Southern Minnesota and Winona & St. Peter companies.

Hoosac Tunnel Line.

The minority of the committee of the Massachusetts Legislature, who are opposed to the consolidation provided for in the majority report, have prepared and submitted a bill. It provides that the State shall take no steps toward consolidation and shall not even provide equipment for its road, but shall hold the Troy & Greenfield road and the tunnel open to

any company which desires to run trains over the line, charging a fixed mileage for all cars. Provision is made for a board of trustees to have the control and management of the line. This plan is said to have the support of the Massachusetts Central interest.

Paterson & Newark.

An adjourned meeting of the old stockholders was held in Paterson, April 10. The committee reported that a statement of what the Erie Company was willing to do had been promised in 10 or 15 days. Mr. Eastwood, of Belleville, was appointed on the committee in place of Enos Cole, and the stockholders adjourned to meet at the call of the Secretary. It is stated that a substantial agreement between the New Jersey and New York stockholders has been reached, and that legal proceedings will be commenced at once if the Erie Company does not offer an acceptable compromise.

Great Western, of Canada.

The company advertises for tenders for the transportation of 6,000 tons of steel rails and fastenings from Montreal or Quebec by water to Hamilton, Ont., or Toronto. The shipment will commence in June and continue until the close of navigation. Proposals will be received at the office in Hamilton until April 22.

New York, Kingston & Syracuse.

Ernest Caylus and others, iron merchants of New York have commenced suit against the directors for the sum of \$79,723, claiming that the directors are personally liable for fraud, because of the violation of their duties in issuing second-mortgage bonds purporting on their face to be first-mortgage bonds, which were taken as collateral by the plaintiffs for iron furnished to the road, and such bonds being valueless.

Oil Creek & Allegheny River.

The Philadelphia Ledger says:—"There is a report on the street that the road may be sold under foreclosure of its second mortgage, which is for \$1,100,000. The first mortgage is \$2,580,000, in all \$3,680,000. The alleged reason for this is a determination not to pay, under any circumstances, certain litigated claims of old standing against the company, on one of which judgment was recently given against the company in a lower court. This particular suit, we understand, is to be carried farther. There are, however, several other claims of large amounts of similar character, but so unjust are they esteemed by some of the parties of largest interest in the company that the threat has found circulation that the company will default in the interest on the second-mortgage bonds and permit the road to go to sale under foreclosure rather than pay them."

Memphis & Charleston.

The Memphis Appeal states that the agreement by which the Southern Security Company gives up the lease includes the payment to the Memphis & Charleston stockholders of \$70,000 in money, 3,500 acres of land and other property to the amount of \$120,000. Another report states, however, that the Memphis & Charleston stockholders will be asked to release the Southern Security Company from the payment of \$160,000 rent due. The terms of the agreement will probably not be definitely known until the stockholders' meeting, which takes place April 29.

Winona & St. Peter.

Much complaint is made concerning the failure to run trains west of New Ulm, Minn., since early in February. It is said that much suffering has been caused among the settlers on the line by the stoppage of trains.

Portland & Ogdenburg.

Work on the line through the White Mountains is being pushed as fast as possible. It is expected that by June 1 the track will reach the old Crawford House, and by September 1 the road will be finished through the Notch nearly to the present Crawford House. This section of six miles is the most difficult on the line and requires a very large quantity of rock cutting, much of which is already done. Work is soon to be commenced on the line from the Crawford House west to the Connecticut River and on the bridge over that river.

Erie.

Mr. S. H. Dunan, the late Auditor, has published another letter, in which he reiterates his former charges and further states that alterations to a large amount were made in the operating and income accounts in order to justify the dividend declared in September. He also charged that the published statement showing the disposition made of the proceeds of \$5,000,000 convertible bonds sold is incorrect. No answer to the latter charges has yet been published, but President Watson, who has just returned from Europe, is said to be preparing a full statement of the company's affairs and an answer to Mr. Dunan's statement. It is stated that arrangements will be made to have the books examined by a committee of experts who are entirely disinterested.

The new ferry-house in Jersey City is completed and has been in use some little time. It has three slips, two for the Chambers street and one for the Twenty-third street ferry, and is conveniently arranged though not very large. A very serious fault in the present arrangement of the passenger depot in Jersey City, and one for which there is no apparent excuse, is the very long distance which passengers are obliged to walk between the cars and the ferry-boat. This will probably be remedied when a permanent depot is built, but meanwhile a better temporary arrangement could easily be made. The iron has been taken up from about 3½ miles, and the ties from about a mile of the second track on the Newark Branch.

Cairo & Fulton.

The special meeting of the stockholders to vote on the proposed consolidation with the St. Louis & Iron Mountain Company will be held at Little Rock, Ark., May 4.

California Railroad Law.

The bill for regulating rates in California failed finally through a disagreement between the two houses of the Legislature, the lower house having refused, just at the close of the session, to pass the Senate substitute for the original bill. The date of adjournment was then fixed and there was no time to arrange a compromise.

Flushing & North Shore.

Efforts are being made to secure the building of the proposed extension from Great Neck, N. Y., eastward to Huntington. Branches from the Long Island Central, which is operated by this company, are also proposed, to run southward to Hempstead Village and from near Westbury to Wheatley. All these proposed lines will be in direct competition with those of the Long Island Railroad Company.

St. Louis, Kansas City & Northern.

A party of the directors, officers and stockholders of this company have been passing over all the company's lines on a trip of inspection. The new shops at Moberly, Mo., received special attention.

Lebanon Valley.

A branch about eight miles long is to be built from Hummelstown, Pa., on this road southward to Middletown on the Pennsylvania road. This will serve as a short-cut line for considerable freight, mainly coal and lumber, which is now carried around through Harrisburg.

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THE CATECHISM OF THE LOCOMOTIVE.

By M. N. FORNEY, Mechanical Engineer.

PART VIII.—(CONTINUED).

THE BOILER ATTACHMENTS.

QUESTION 144. What is the steam-whistle, and for what purpose is it used?

Answer. The steam-whistle, W, fig. 71, and shown in section in fig. 81, consists of an inverted metal cup or bell, A, made usually of brass. The lower edge of this cup is placed immediately over an annular opening, a, a, from which the steam escapes and strikes the edge of the cup or bell, which produces a deep or shrill sound, according to the size or proportions of



Fig. 71.

the whistle. The annular opening, a, a, is formed by the plate or cover, a, a, which nearly fills the mouth of the cup B, which is attached to the stem c. This is screwed into the top D of the dome. Communication with the steam-space of the boiler is either opened or closed by a valve, b, which is attached to a sort of spindle, d, which extends upward inside of the stem c. This spindle does not entirely fill the opening in the stem c, so that the steam which enters when the valve b is opened rises and escapes through the holes, e, e, into the cup B and out through the annular opening a, a. The valve is opened by the lever K, whose fulcrum is at f. The end g of this lever is connected by a rod, h, figs. 81 and 71, with the end, and by a suitable handle or lever, h, fig. 71, it can be opened and the whistle be blown at any time by the locomotive runner or fireman to give signals to the trainmen or of the approach of a train to a station, or to warn persons to get off of the track.

QUESTION 145. How is a locomotive boiler emptied and cleaned?

Answer. One or two large cocks, called blow-off cocks, X, fig. 71, are provided and are placed near the bottom of the fire-box, either in front or behind, and sometimes on the side. By opening these the water in the boiler is blown out, and much of the loose mud and dirt is carried out with the water. The cock, X, fig. 71, is opened by a handle, u, which is connected with the cock by a rod.

In order to clean out the mud and scale which is not entirely loose, what are called mud-holes or hand-holes are placed in the corners of the fire-box near the bottom. These are oval-shaped holes, about 4½ inches long and 2½ inches wide, and covered with

two metal plates, one of which is put inside the boiler and the other outside, and fastened with a bolt through both. Another hand-hole is sometimes placed in the bottom of the front tube-sheet. When the boiler is emptied of water these hand-holes are uncovered and as much dirt is removed as can be scraped out of these holes. A hose pipe is then inserted and a strong stream of water is forced in, which washes out nearly all the loose dirt, so as to leave the boiler comparatively clean.

Where the water is very impure, what is called a mud-drum, M, fig. 44, is used. Much of the mud and dirt are deposited in this receptacle, from which it can easily be removed by taking off the cast-iron cover on the bottom of the drum. The cover is also provided with a blow-off cock, only the opening for which is shown in the figure referred to.

QUESTION 146. What other attachments are there to the boiler of a locomotive?

Answer. There are two cocks, a, a, fig. 71, called heater-cocks, connected with pipes to the feed-pipes, D, D, to admit steam to the latter to prevent them from freezing. There is another cock, b, called a blower-cock, which is connected to the smoke-stack by a pipe, b. Steam is conducted through this pipe and escapes up the chimney in a jet, thus producing a draft when the engine is not working. This arrangement is called a blower and is used to blow the fire when the engine is standing still. The action of the jet is similar to that of the exhaust steam which escapes up the chimney, excepting that the steam from the jet escapes in a continuous stream instead of distinct "puffs," as it does when it is liberated alternately from one end of the cylinders and then from the other.

T is a handle which is connected by a rod, T, T, with the feed-cock (not shown in the engraving) in the pipe D. This cock can be opened or closed by the handle, and the supply of water fed into the boiler by the pump can thus be regulated. J is a handle on the other side of the engine, for regulating the working of the pump on that side.

E, e are handles, also connected by rods with the pet-cocks on the pumps. These cocks can thus be opened or closed, and it can then be known whether the pumps are working.

A is the furnace door, which is fastened by a latch. The latter has a chain, Q, attached to it by which it can be conveniently opened or closed. The door also has a circular register with six holes to admit air into the furnace. These holes can be opened or closed by the revolving circular disc shown in the engraving.

QUESTION 147. How are the grates constructed?

Answer. As has already been explained, they are made usu-

Fig. 82.

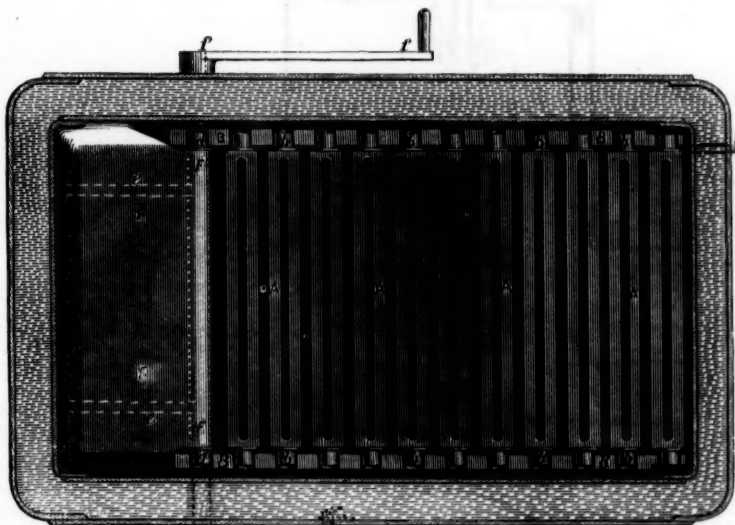


Fig. 83.

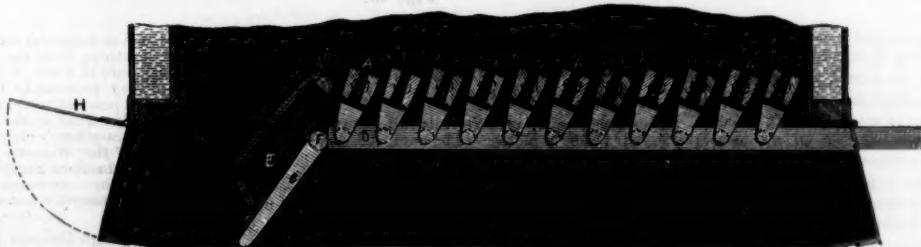
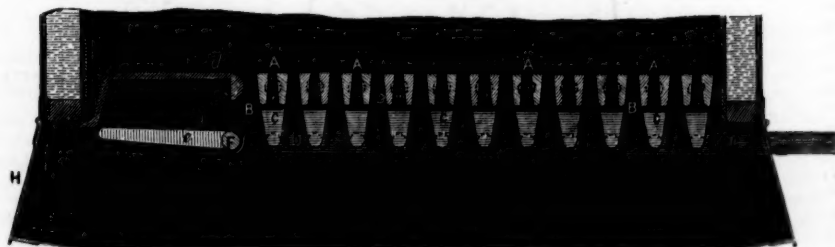


Fig. 84.

ally of cast-iron bars, * A, A, figs. 82 and 83, called grate-bars. Fig. 82 is a plan, and fig. 83 a horizontal section of one form of grate. The bars in this kind of grate are usually cast in pairs, or sometimes three or more are cast together. They are made wider on the top than on the bottom edges, as shown in the section, fig. 83, so that cinders and ashes will fall through easily, and also to give free access to the air from below. They are usually from ¾ to 1¼ inches wide on the top, and about ¼ inch on the lower edges. The spaces between the bars are made from ¼ to 1¼ inches wide. For burning wood the bars are placed comparatively close together and are stationary, but for burning bituminous coal they are usually made so that they can be moved, in order to shake or stir up the fire, just as is necessary in an ordinary stove or grate fire. In the grate we have illustrated the bars, A, A, are cast in pairs, and run crosswise of the fire-box. The ends are made with a sort of journals, b b, which rest on two supports, B B, called bearing-bars,

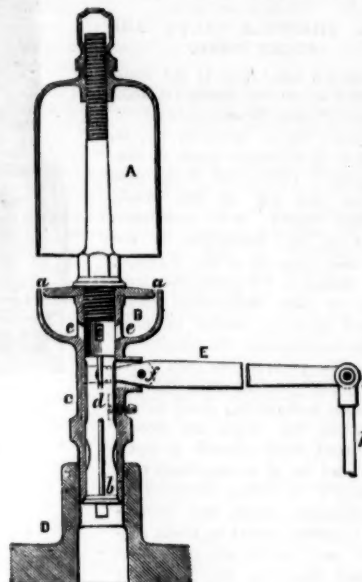


Fig. 81.

which have suitable indentations to receive the ends of the grate-bars. The latter have arms, C C, fig. 83, cast on the under side, to which a bar, D D, is attached. By moving this bar back and forth, the grate-bars have a rocking motion imparted to them, as shown in fig. 84. It is evident that in this way the fire over the whole surface of the grates will be disturbed or shaken. The bar, D D, is moved by a lever, m m, shown in fig. 71. An extension piece, not shown in fig. 71, is used with the lever, m m, so as to increase its length: but it is removed after it has been used, so as not to be in the way of the fireman. Grates which have movable bars are called shaking or rocking grates. A great variety of such grates are made and in use, to describe which would require more room than is available here.

For burning anthracite coal what are called water grates are used. These consist of wrought-iron tubes, 2 inches in diameter outside, which are fastened in the front and back plates of the fire-box and are inclined upward from the front end, so that there will be a continued circulation of water through them to keep them cool and thus prevent them from being burned out by the intense heat of the fire.

QUESTION 148. How is the fire removed from the fire-box when it is necessary to do so?

Answer. In bituminous coal burning engines, what is called a drop-door, F F, figs. 82, 83 and 84, is provided for that purpose. This door is supported partly on journals, d d, similar to those in the grate-bars, on which it can turn, and is held up or prevented from dropping by arms, e e, attached to a shaft, F F. This shaft is operated by a lever, f f, fig. 82, outside the fire-box.

* In Europe and in some few cases in this country they are made of wrought iron.